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JOURNAL and Proceedings of the INSTITUTION of AGRICULTURAL ENGINEERS

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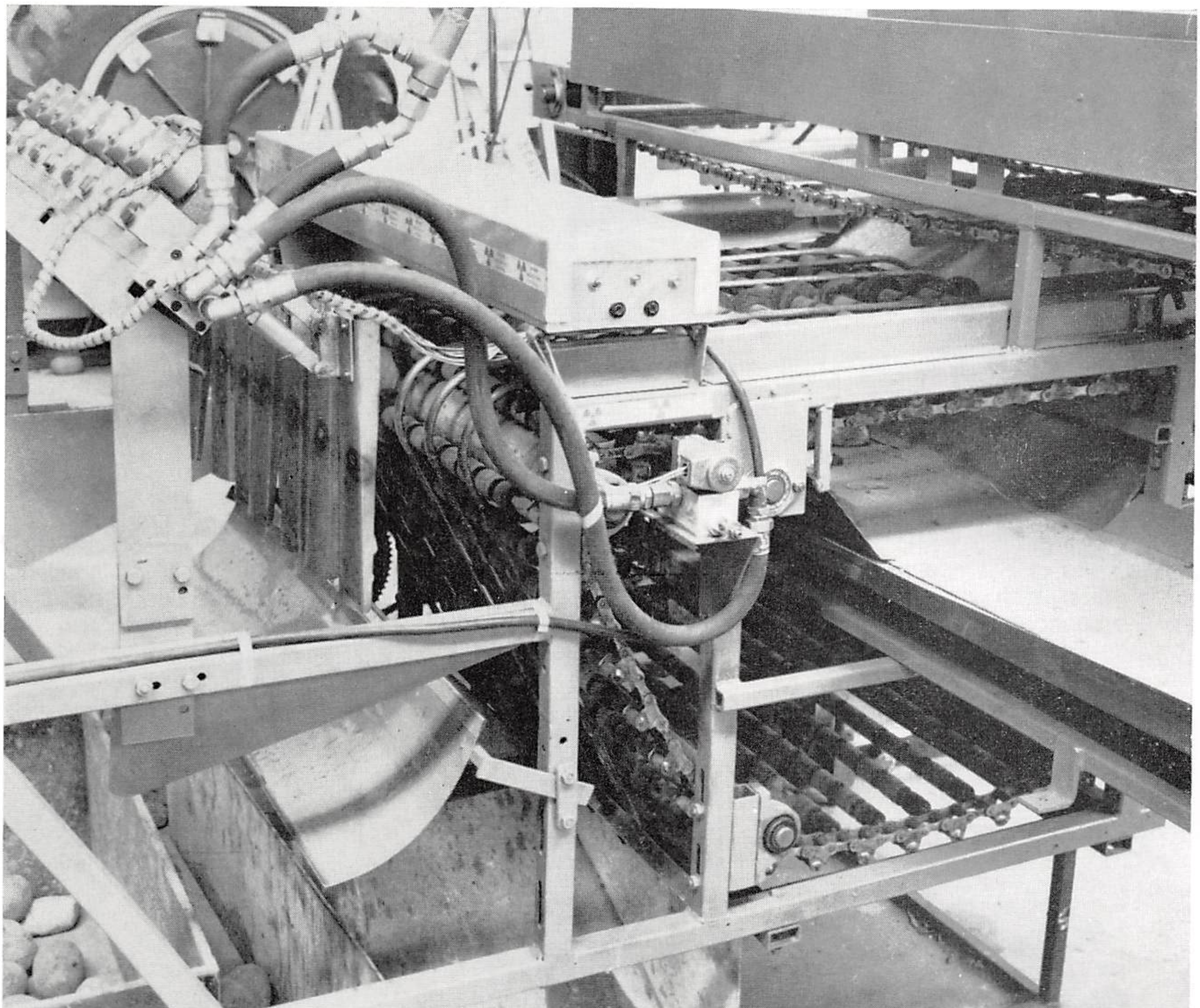
CONFERENCE ISSUE: Sugar Beet & Potato Production In Europe



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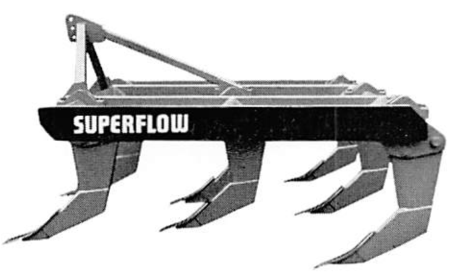

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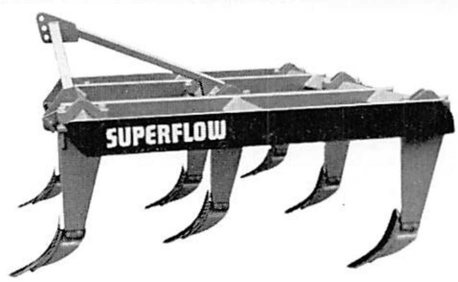

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CONTENTS

Front Cover: Within the boundaries marked on the map lie 15 member countries of *CIGR*.

GUEST EDITORIAL

The Meeting Of The 3rd Section Of CIGR*

by F. Coolman†

THE role of Great Britain in the international field of farm mechanisation knowledge found once again expression in the organised meeting on potato and sugar beet growing. The initiative was taken by the Institution of Agricultural Engineers in close co-operation with the Third Section of *CIGR*. The numerous individual contacts of British specialists with colleagues from other countries were strongly promoted by the reports, discussions and talks during the days at the National College of Agricultural Engineering, Silsoe. International co-operation is presently regarded as a must. Even the total national input in research and development activities is not enough to warrant the necessary support to apply results to the practice. Also the international trade in farm machinery is underlining the need of exchange of knowledge and experience. Therefore *CIGR* is very grateful that the Institution and the College enabled aproximately 85 specialists from eight countries to co-operate in a sound manifestation. Hence they fulfilled the main aims of *CIGR:* the promotion of scientific exchange in agricultural engineering; the promotion of contacts and good understanding; the spreading of knowledge amongst all those persons who can benefit by it; and as a sideline: to make friends or to renew already existing friendships. Also in this aspect the Silsoe meeting of Section III of *CIGR* was a success. The facilities at the College supported to a high degree these results.

Going somewhat deeper into the details of the themes I should like to first point out the success of the (new) set-up of the treatment of the themes. Normally every participant can deliver his report at an international meeting; sometimes the reports are summarised to introduce discussions or to indicate discussion topics.

The organisers of the Silsoe meeting worked out their scheme in a slightly different way, partly based on the experience of their national working conferences. They invited well-known speakers, and their papers gave the basic material for the discussions. The advantage of selected topics in the themes is clear, the approach to the subject is far better guided and directed. This set-up also permitted each day to start with an overall view of the crop, and the actual part of mechanisation could be defined, ie serving crop-production and being one of the main entrances to farm economy to reduce production costs, also being for the farm manager the way to grow big areas with less labour or being less dependent on labour supply.

The technical information following the general introduction of the crop received more background and content due to this way of presentation. It may be regarded as an example for other meetings in the field of mechanisation, operational costs, labour and farm management.

From the reports and the discussions, which are published in this issue of The AGRICULTURAL ENGINEER it will be clear, that mechanisation in potato and sugar beet growing has made enormous progress. From the first mechanisation stage, labour requirements dropped to 10-15 per cent and in some cases even below this percentage. It would be impossible in most of the west European countries to grow these crops in a way as we did 20 years ago. Being dependent on machines also means, that the jobs have to be carried out very efficiently. A missing link at the beginning of the chain of operations sometimes means extreme difficulties later-on. When for instance the ridge making in potatoes is not done carefully enough, the harvester can run into troubles. When thinning or stand planting of sugar beet has been incorrectly planned, crop losses will follow. The papers, given in the sessions indicate a number of these difficulties. Methods of overcoming the difficulties are also discussed. This simple example of the task of mechanisation and of the workers behind this important part of the total farm activity illustrates one of the main considerations on the "Silsoe working days". It illustrates also the connection with the real practice in the discussions.

Finally I would like to express my gratitude to the British members of the Institution who attended the meetings and the willingness they showed for international co-operation. This is well demonstrated by the combination of this double issue of the Institution's *Journal* with the official report of a *CIGR* meeting acting as a real symbol of our common effort. Specially therefore I want to express my cordial gratitude.

* *Silsoe, Beds. 1-4 October 1972.*
† *President Section III, CIGR.*

Agricultural Engineers And The Wider World*

THE presence at the Conference of so many from the continent is most welcome evidence of the community of interest in our professional work which extends already across the frontiers of our various countries. Agricultural engineers have a vital part to play in the future. Their task is to increase the production of food throughout the world, by easing the work of farmers at all stages of technical development and competence, by the introduction of new techniques, by the improvement of existing methods and by advice and planning at the level of individual farms, and on a regional or national scale.

One of the great problems facing the agricultural producers of western Europe, and the agricultural engineering industry which serves them, lies not in the technical or economic fields but rather in the political field. In the technical field we are in no way lacking for new ideas, new techniques, new systems, which could be developed to the advantage of farmers and of the vast non-farming populations who depend on the food they produce.

Important decisions are now being taken by people who are less influenced by agricultural considerations than ever before in our history, who may well retain in their minds an uninformed or even totally erroneous concept of farming and of the agricultural engineering industry which supports it, and who may be unduly influenced by some of the bodies of opinion now dedicated to controlling certain farming activities which are either based on well-proved traditions, or have developed to meet the economic constraints of today.

In England we have reached the stage at which less than 2 per cent—in the *UK* as a whole, 3 per cent—of the population is concerned with practical farming, and in consequence the agricultural vote is, in general, of very limited importance. Behind this reduction in the political power of agriculture, inevitably the influence of agricultural engineering in the affairs of state is also diminishing.

As technical people, we must become aware that our technical proficiency has already proved to be so effective in reducing the number of people employed on the land that we must also concern ourselves with the essentially political problems faced by a small minority in trying to maintain a beneficial influence on the great mass of ill-informed public opinion. This must be a matter of informing and educating those who are in a position to make decisions affecting our work. The areas where agricultural engineers at least have an interest and may have a constructive part to play include questions affecting water pollution, air pollution, disposal or treatment of waste products, the aesthetic appearance of buildings, the use of chemicals for pest and weed control, avoidance of cruelty to animals and the provision of suitable internal environmental conditions. The welfare of the farmer and farm worker must also be borne in mind, in terms of ergonomics applied to tractor, machine and workplace design and construction, the avoidance of dust and other aspects of comfort and hygiene.

The urgent need is for agricultural engineers to understand and grasp the possibilities offered by their places in the wider world surrounding them. I trust and hope that our Institution and *CIGR* will endeavour to provide guidance and leadership in these broader fields, as well as providing a focus and forum for our more technical activities.

This issue of The AGRICULTURAL ENGINEER incorporates Winter 1972, Vol. 27, No. 4

* *Summary of Speech at CIGR Conference Dinner at Silsoe on 2 October 1972 by J. A. C. Gibb.*

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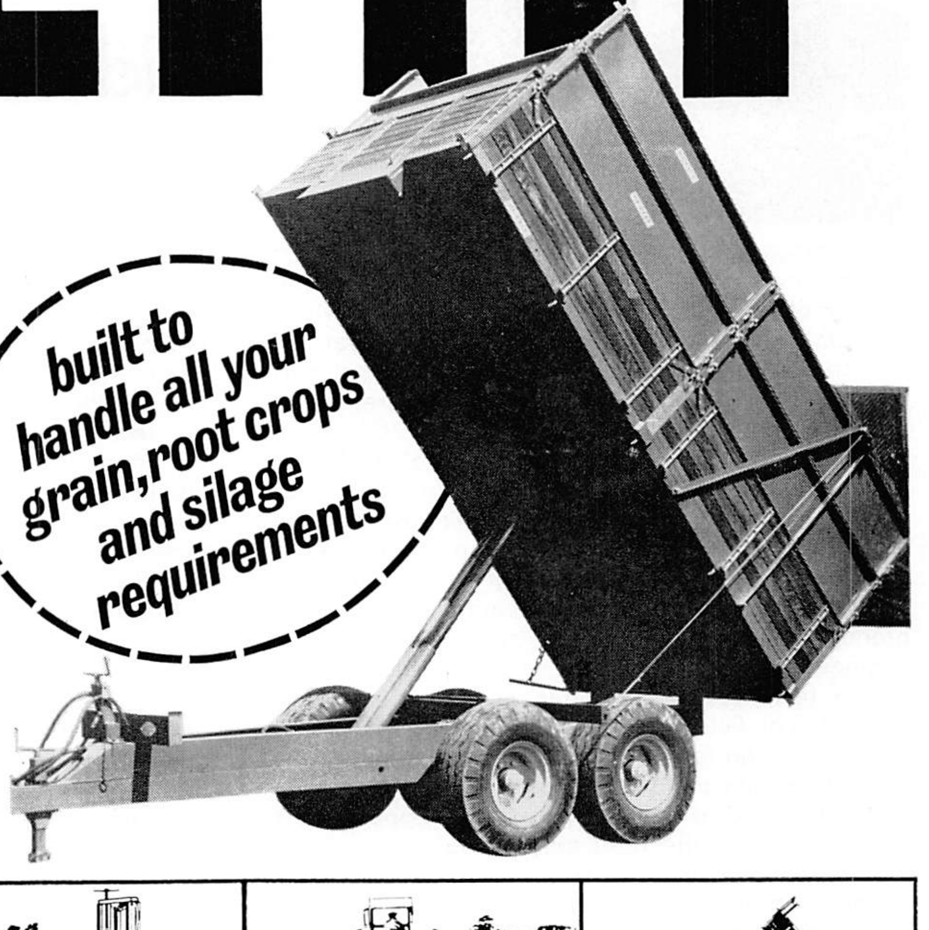

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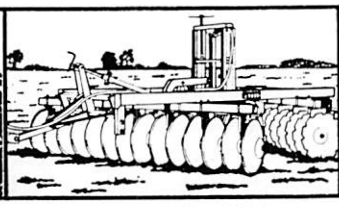

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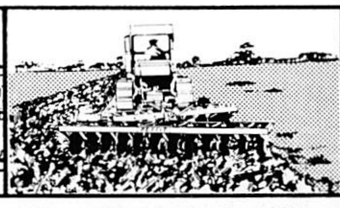

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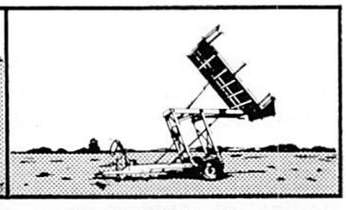

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Etude de la production Européenne de la Betterave a sucre

J. Jorritsma

DANS les pays Européens, le sucre est une source d'énergie importante, et sa production est souvent soumise à des pressions politiques. Les gouvernements, veulent assurer l'approvisionnement, et par conséquent, essayent l de rendre la récolte profitable pour le fermier qui la place sous le contrôle de régisseurs.

Cette étude comprend six pays: la Belgique, le Danemark, la France, l'Allemagne, les Pays-Bas et la Suède, où la culture de la betterave à sucre est concentrée sur des sols fertiles, au pH élevé et de structure favorable. On y traite de la tendance à l'augmentation de la surface cultivée par chaque fermier. La France mise à part, 80 pour cent des fermiers de l'Europe de l'Ouest continuent à en cultiver moins de 5 ha.

On y étudie l'usage du monogerme et des graines enrobées.

On y mentionne le rôle des régisseurs dans la mécanisation.

Les rendements, la pratique de l'effeuillage, la récolte et l'époque du traitement, les coûts, les méthodes de paiement de la récolte, la propriété des plantes en traitement, tout y est comparé dans les 6 pays.

Préparation du Sol et Etablissement de la Récolte de la Betterave a sucre

M. Martens

UNE étape dans la mécanisation a été atteinte, et qui rend maintenant de nouvelles réductions de main d'oeuvre très difficiles, mais la mécanisation a un grand avenir dans l'accroissement du rendement total du sucre. La mécanisation a, dans le passé, tendu à diminuer le rendement, en comparaison avec les méthodes manuelles; mais d'autres facteurs ont aidé à donner, pendant les 20 dernières années en Europe, un accroissement annuel constant en sucre de 100 kg/ha. Comme la betterave a une longue période de croissance, si l'on avance la date de la semence, et si l'on recule la date de la récolte, le rendement en sucre et la qualité du jus peuvent être augmentés de beaucoup. Une semence de haute capacité et une récolte mécanique peuvent rapidement atteindre ce but, tout comme la prépation des sillons et des semailles qui devront avoir lieu sur un sol humide, et sans domage pour la structure du sol. L'épandage des engrais par des machines lourdes retarde souvent la date des semailles; cette opération peut se faire sur des sols gelés avec peu de perte d'engrais.

En octobre, un retard dans le récolte, donne un rendement de 87 kg/ha et par jour de sucre blanc. Ceci peut être fait grâce à des machines de grande capacité et grâce à la synchronisation du transport à l'usine sans pour autant avoir à changer l'époque de travail de l'usine.

Developpements dans pa Préparation de la Mécanisation des sols et Etablissement de la Recolte de la Betterave a sucre

D. R. Brisbourne

LES développements en ce qui concerne les graines, leur espacement, et les herbicides ont abouti à 8 pour cent de la récolte 1971-72 sans aucun travail manuel dans le Royaume Uni. Les trous pour les graines doivent être espacés de 15 cm environ.

Dans l'Est de l'Angleterre, le travail manuel est encore possible, et un excès de rendement paiera pour ce travail. Dans l'Ouest, le travail y est très rare et le climat permet une meilleure germination.

Le pH et le sodium jouent un rôle important dans la préparation des sillons. L'emploi de la herse est recommandé ainsi que le rouleau et le pulvérisateur. Ceci empêche les mottes de terre de remonter à la surface, des roues élargies devraient être utilisées pour toutes les opérations et cultures faites juste avant la plantation.

Soixante trente sept pour cent des semences faites dans le Royaume Uni sont de deux manoeuvres précises; Une en utilisant une courroie, l'autre en utilisant une roue verticale avec des trous dans so circonférence. La profondeur des trous est de 18 à 25 mm.

Le Royaume Uni utilise maintenant 64 pour cent de monogermes en grains, 25 pour cent de graines enrobées de polyphiols et 90 pour cent des récoltes reçoivent un traitement herbicide. Le chiendent et l'avoine sauvage constituent le problème principal et les recherches courantes y sont décrites.

Seulement 1,1 pour cent de la récolte est aminci mécaniquement.

→ *page 6*

Différentes Tendances des Machines a Récolter la Betterave a sucre et Differents Procédés de Maniage

W. Brinkmann

PENDANT les dix dernières années la récolte de la betterave, les procédés d'effeuillage et de transport, tout cela est pratiquement fait mècaniquement.

Il y a trois phases dans le déroulement de la récolte et l'usage d'une seule machine est une chose commune. Cependant des procédés semi-mécaniques sont encore utilisés dans certaines régions, alors que dans d'autres, des procédés des machines différentes pour chaque phase sont envisagés. Ces systèmes nécessitent une plus grande équipe de travailleurs mais ont un prix d'achat plus bas et à cause du grand rendement, la durée de la récolte est réduite. Des procédés à grande production sont très difficiles à obtenir avec une seule machine faisant toutes les opérations; ceci est du à la grande puissance requise, aux problèmes de coulissage. La capacité du procédé dit à rangées multiples tend à ètendre les cultures dans la majorité des fermes, amenant à la nécessité de coopération entre les fermiers.

Evaluation du Travail des Machines Employées dans la Culture de la Betterave a sucre

G. L. Maughan

CETTE évolution des actions fut introduite tout d'abord lors de la Démonstration Nationale de la Récolte de la Betterave à Sucre de 1950.

Les données réunies permettent des comparaisons entre les machines et les demandes des utilisateurs, des ingénieurs et des conseillers pour les différents sujets. Il faut aussi considerér l'effet des machines spécialisées sur le procédé de production.

L'évolution des exercices d'entraînement nécessitent l'étude de:

1. la facilité à séparer les graines entre le réservoir et la semeuse.
2. la bonne condition du sol où l'on va travailler.

L'importance du degré de précision doit être estimé d'après la pratique. Ceci doit se faire seulement dans une tranche de 20 pour cent de l'espacement déjà nommé.

On doit compter de façon répétée l'espacement des graines et la sortie de terre; ceci doit assurer une bonne évolution et prend beaucoup de temps.

En ce qui concerne les machines employée pour la récolte et les opérations d'effeuillage, d'arrachage, de chargement et de transformation, tout doit être étudié simultanément. Les procédés multiples sont liés à la capacité des machines plus lentes.

Les résultats du développement du travail des machines lors de démonstrations publiques, sont rarement significatives mais peuvent-être utiles, à partir du moment où les machines travaillent dans des conditions semblables.

Etude de la Production Européenne de la Pomme de Terre

J. M. Glotzbach

LA production de la pomme de terre dans les pays de la *CEE* a décliné durant les dix dernierès années. La surface cultivée a diminué de moitié, mais le rendement sur ces surfaces a considérablement augmenté.

Pendant un même laps de temps, des changements considérables ont eu lieu dans l'emploi de la récolte, ainsi qu'un déclin de la consommation de l'homme et des quantités en réserve. Les utilisateurs demandent plus de pommes de terre, mais la croissance n'a pas été aussi spectaculaire qu'aux *USA*.

Sur le Continent, les prix ont varié plus qu'au Royaume Uni. La France, en particulier, n'a pas encore trouvé d'accord avec le reste de l'Europe des six sur les règles du marché des importations et des exportations.

A l'intérieur de la *CEE*, un important mouvement de la pomme de terre a lieu, du Sud au Nord et vice-versa, l'auteur voit un grand avantage à un tel commerce sans restriction et indique aussi qu'il existe des utilisations de la récolte encore pratiquement inexplorées.

Aspects de la Préparation du Sol et de la Plantation de la Pomme de Terre

G. J. Poesse, U. D. Perdok, E. Strooker

UNE préparation réussie du sol, dépend du degré d'humidité, et nécessite une couche de terre fine de 100 mm de profond qui peut être aussi un sillon de 500 mm de base et de 250 mm de haut. La méthode employée pour l'obtenir dépend du type du sol; elle présente quelques petits problèmes. Des sols plus lourds ont besoin de l'aide du froid et de l'emploi de herses on de machines rotatives. La conservation de l'humidité dans le sillon est essentielle et alors la plantation doit être faite rapidement.

Les planteurs doivent mettre la pomme de terre en ligne, à la même profondeur et à la même distance. La germination est importante, en particulier pour produire la pomme de terre de semence. Les planteurs qui mettent en terre des pommes de terre germées sans les abimer sont très lente dans leur travail. Des modifications de la machine à planter les pommes de terre germées diminuant les risque de dommages, ralentissent aussi le rythme du travail. Le procédé de scellement en terre crée peu de dommages, mais la précision se trouve réduite et un travail supplémentaire est nécessaire.

La destruction des feuilles est nécessaire pour éviter l'apparition du virus sur les pommes de terre de semence, ou son infection et elle se fait par flétrissure et facilite le travail pendant la récolte. Des procédés chimiques sont maintenant très répandus mais ils polluent le sol. Les destructions par le feu ou la vapeur ont été expérimentées mais sont des procédés couteux et facteurs de pollution de l'air. Les méthodes mécaniques semblent plus prometteuses pour le futur.

Aspects de la Préparation du Sol et de la Plantation de la Pomme de Terre

F. E. Shotton

Plantation

LA plupart des techniques utilisées dans le Royaume-Uni ont vu leur origine en Hollande, en particulier l'idée que les cultures ne doivent pas seulement avoir pour but une bonne récolte, mais aussi une aide de la machine pour la récolte, entraînant une diminution de la main d'oeuvre.

Les sols de l'Est de l'Angleterre avec plus de 30 pour cent d'argile, présentent des problèmes de pénétration du gel, la couche collante en surface et le tassement par les roues du tracteur.

Les premières expériences d'utilisation des herses ont nécessité plus de labourages entre les rangées et réduisent le rendement. Une culture plus profonde produit des mottes de terre et la récolte se trouve elle aussi plus profonde. Le contrôle chimique des mauvaises herbes s'est prouvé avantageux dans de telles conditions. Sur des sols vaseux, les pommes de terre vertes créent quelques problèmes dus au craquèlement de la surface. Des sillons plus larges le réduisent.

Le gypse (sulfate de calcium) peut réduire la formation des mottes de terre. Les outils rotatifs se sont prouvés efficaces, des rangées plus larges ont besoin de moins de labourages et d'une vitesse de récolte moins grande.

Culture

La pré-germination augmente le rendement de 3,5 t/ha; 15 mm est la longueur maximum des germes et ceux qui mettent plus de temps à pousser sont plus résistants. Les machines actionnées à la main causent moins de dégats que les machines automatiques.

Une plantation irrégulière peut causer une réduction dans la qualité pour la vente de la récolte. Une vitesse plus grande dans la plantation influe sur un certain nombre d'autres facteurs et des essais sont nécessaires pour déterminer un système qui augmente le profit plutôt que le rendement.

Developpements Récents dans la Récolte Mécanique de la Pomme de Terre

D. C. McRae

L'APPARITION du procédé de séparation par les rayons x a marqué un tournant et les futurs projets dépendront en grande partie du déroulement de ce système.

Les techniques utilisant les rayons Gamma ont été essayées et on a obtenu des bons résultats dans un pourcentage de 94 à 96 pour cent. Le dosage des radiations empêche la germination et la sécurité des ouvriers est importante, car les degrés des radiations sont dangereux. Une machine utilisant ce système est cependant meilleur marché qu'un système électronique.

Huit pour cent des dommages sont attribués au maniement entre la machine et l'entrepot. Une étude a montré que la hauteur de chute dans la plupart des cas était supérieure à 470 mm; c'est au dessus de cette hauteur que les dommages arrivent. Des expérience utilisant un transporteur ajustable ont prouvé des réductions importantes dans les dommages.

Evaluation des Procédés de Récolte Mécanique de la Pomme de Terre

I. Rutherford

EN 1971 des recherches de l'*ADAS* (Agricultural Development and Advisory Service) et du *PMB* (Potato Marketing Board) ont permis l'étude, dans toute la Grande Bretagne, de 30 modèles de machines. Les résultats donnés par huit différents types de machines ont été enregistrés dans 192 fermes. Des cartes contenant ces records fournissent les données sur la quantité de travail de 249 machines pendant un trimestre. Les pommes de terre laissées sur le terrain, les dommages de la récolte, les maladies, furent mesurés. Les principaux résultats furent les suivants.

1. En théorie les possibilités de la machine sont satisfaisantes, mais ne sont pas assez exploitées dans certaines fermes.
2. Le transport depuis le champ réduit sérieusement la rentabilité des machines, lorsqu'elles ne sont pas utilsées comme elles devraient l'être.
3. La plupart des machines laissent 1,25 t/ha de pommes de terre dans le champ, et cette perte ajoutée à plus de 5 pour cent de pommes de terre endommagées, représente une perte financière d'environ 25£ par acre (700 F/ha) dans beaucoup de fermes.

Ein Blick über die Zuckerrübenproduktion in Europa

J. Jorritsma

IN den europäischen Ländern ist der Zucker eine wichtige Energiequelle, und seine Produktion wird oft von politischen Betrachtungen beeinflusst. Da die Staatsregierungen das Angebot sichern wollen, wird der Zuckerbau für den Landwirt rentabel gemacht und mit den Rübenabnehmern vertraglich gesichert.

In sechs Ländern, nämlich Belgien, Dänemark, Frankreich, Deutschland, den Niederlanden und Schweden, wo der Zuckerrübenbau auf fruchtbaren Böden mit hohem pH-Wert und guter Struktur konzentriert ist, wurde eine Umfrage angestellt. Die fortschreitende Vergrösserung der durchschnittlichen Anbaufläche einzelner Landwirte in den sechs Ländern wird erörtert. Mit der Ausnahme von Frankreich werden von 80% der Zuckerrübenbauern immer noch weniger als 5 Hektar angepflanzt.

Die Entwicklung bezüglich der Anwendung von monogerm und pilliertem Saatgut, sowie die Rolle der Lohnunternehmer in der Mechanisierung des Zuckerrübenbaues, werden besprochen. Zwischen den sechs Ländern werden Vergleiche gezogen in Bezug auf Zuckerertrag, Köpfverfahren, Ernte- und Verarbeitungsperioden, Produktionskosten, Entgeltung und Finanzierung der Zuckerfabriken.

Bodenbearbeitung und Anbau von Zuckerrüben

M. Martens

IN der Mechanisierung ist ein Entwicklungsstadium erreicht worden, was eine weitere Erniedrigung des Arbeitsaufwandes erschwert, jedoch den Gesamtertrag an Zucker vorteilhaft beeinflussen kann. Im Vergleich zu Handmethoden hat der Maschineneinsatz früher den Ertrag verringert, aber andere Massnahmen haben in Europa während der letzten 20 Jahre einen ständigen Ertragsanstieg von 100 kg/ha hervorgerufen. Zuckerrüben benötigen eine lange Wachstumsperiode, sodass ein frühes Säen und spätes Ernten den Zuckerertrag und die Saftqualität bedeutend verbessern können. Um diese Forderungen in die Wirklichkeit umzusetzen, werden Maschinen mit grosser Leistung gebraucht die es ermöglichen, zeitsparend zu säen und zu ernten, sowie das Saatbett unter feuchten Bodenverhältnissen ohne Strukturschäden vorzubereiten und zu bestellen. Durch das Streuen von Kunstdünger mit schweren Maschinen verzögert sich die Aussaat oft; das Düngerstreuen kann aber im Winter bei gefrorenem Boden durchgeführt werden, ohne dass viel Nährstoffe nachweislich verloren gehen.

Im Monat Oktober bringt ein späteres Ernten einen zusätzlichen Weisszuckerertrag von 87 kg/ha/Tag. Eine Verzögerung von 15 Tagen kann durch den Einsatz von hochleistungsfähigen Erntemaschinen und der Synchronisierung des Abtransportes ermöglicht werden, ohne dass die Arbeitssaison der Zuckerfabrik verändert werden braucht.

Entwicklungen in der Mechanisierung der Bodenbearbeitung und –bestellung beim Zuckerrübenbau

D. R. Brisbourne

NEUE Erkenntnisse in Bezug auf Saatgut, Saatabstand und Unkrautbekämpfungsmittel haben dazu geführt, dass 1971/72 etwa 8% des Zuckerrübenbestandes in Grossbritannien ohne Handarbeit gebaut worden ist. Als Direktbestand bezeichnet man es, wenn der mit der Drillmaschine erzielte Saatabstand mehr als 12,5 cm beträgt.

Im Osten Englands sind Arbeitskräfte noch erhältlich, und der damit erzielte Mehrertrag begleicht die Arbeitskosten. Im Westen sind Arbeitskräfte weniger leicht zu haben, und das Klima begünstigt den Pflanzenaufgang.

Bei der Saatbettvorbereitung sind der pH-Wert und Natriumgehalt des Bodens von Wichtigkeit. Die Anwendung von Eggen mit geraden Zinken in Verbindung mit Schleifen und Krümelrollen wird vorgeschlagen. Dadurch werden keine groben Bestandteile an die Oberfläche gebracht. Für alle Arbeitsgänge sollten Gitterräder verwendet werden, und die Saatbettvorbereitung sollte erst kurz vor der Bestellung stattfinden.

In Grossbritannien werden für 97% der Anbaufläche zwei Typen von Drillmaschinen benutzt: die eine verwendet einen Säriemen und die andere ein aufrecht stehendes Särad mit Löchern in der Peripherie. Die Sätiefe beträgt 18-25 mm. Etwa 64% des Saatgutes ist pilliertes monogerm und 25% pilliertes polyploid; 90% des Gesamtbestandes wird mit Unkrautbekämpfungsmitteln bespritzt. Quecke und wilder Hafer bilden das grösste Unkrautproblem; gegenwärtig stattfindende Untersuchungen diesbezüglich werden beschrieben. Nur 1,1% der Anbaufläche wird mechanisch vereinzelt.

→ page 9

Richtungen in der Entwicklung von Erntemaschinen und –systemen für den Zuckerrübenbau

W. Brinkmann

IN den letzten zehn Jahren sind die Ernteprozesse Köpfen, Roden, Reinigen und Transport fast völlig mechanisiert worden. Der Ernteprozess besteht aus drei aufeinander folgenden Phasen, und Verfahren, die eine einzige Maschine zur Vollernte benutzen, sind weit verbreitet. Teilmechanisierte Verfahren werden in manchen Gegenden noch angewandt, während man woanders die Mechanisierung jeder einzelnen Phase in Angriff nimmt. Diese Verfahren benötigen mehr Handarbeit, dagegen ist aber der Kapitalaufwand gering und die Leistung gross, sodass die Erntesaison verkürzt wird. Wegen des hohen Kraftbedarfes sowie der Radlast und des Schlupfes ist es schwierig, dieses Hochleistungssystem durch eine Maschine, die alle Arbeitsstadien bewältigt, zu verwirklichen. Die Leistungsfähigkeit von mehrreihigen Ernteverfahren ist auf grössere Flächen als auf der Mehrzahl der Betriebe bebaut werden abgestimmt; deshalf ergibt sich die Notwendigkeit der Zusammenarbeit von Zuckerrübenbauern.

Leistundswertung bei Zuckerrübermaschinen

G. L. Maughan

LEISTUNGSMESSUNGEN während öffentlicher Vorführungen wurden in England im Jahre 1950 für Zuckerrübenerntemaschinen eingeführt. Die Ergebnisse solcher Messungen lassen Vergleiche zwischen verschiedenen Maschinentypen zu und sind für Gebraucher, Konstrukteure und Berater aus unterschiedlichen Gründen nützlich. Der Einfluss besonderer Maschinen auf das gesamte Produktionssystem muss auch in Betracht gezogen werden.

Zur Beurteilung von Saatgeräten muss Folgendes untersucht werden:

1. die Genauigkeit, mit der einzelne Samen aus der Gesamtmenge im Saatkasten abgeschieden werden,
2. die Eignung der bodenbearbeitenden Maschinenteile.

Die Wichtigkeit der Sägenauigkeit muss in die richtige Perspektive gesetzt werden, denn eine zwanzig prozentige Abweichung vom Sollabstand ist zulässlich. Um eine faire Beuteilung zu sichern, müssen die Saat- und Auflaufabstände mehrmals wiederholt gezählt werden, was sehr zeitraubend ist.

Bei Erntemaschinen müssen die ineinandergreifenden Teilprozesse, wie Köpfen, Heben und Laden, sowie die Gesamtleistung gleichzeitig beurteilt werden. Mehrstadiensysteme sind an die Geschwindigkeit des langsamsten Vorganges gebunden.

Die Ergebnisse von Leistungswertungen während öffentlicher Vorführungen sind selten signifikant doch gewöhnlich äusserst nützlich, denn der Maschineneinsatz erfolgt unter gleichen Arbeitsbedingungen.

Umschau der Europäischen Kartoffelproduktion

G. M. Glotzbach

IN den Ländern der *EWG* ist in den letzten zehn Jahren die Kartoffelproduktion zurückgegangen. Die Anbaufläche für Kartoffeln wurde fast um die Hälfte verringert, dagegen ist aber der Ertrag von dieser Fläche stark angestiegen.

Die Verwendungsart dieser Kultur hat sich jedoch während derselben Zeitspanne sehr verändert, mit einer Verringerung der Verwendung als Speisekartoffel und Viehfutter. Mehr Kartoffeln werden weiter verarbeitet, aber diese Entwicklung ist nicht so stürmisch wie in den Vereinigten Staaten.

Am Europäischen Festland haben sich die Preise mehr als in Grossbritannien verändert. Besonders haben die Franzosen die Einfuhr/Ausfuhr Verkaufsbedingungen der anderen Länder in der *EWG* noch nicht eingeführt.

Zwischen den nördlichen und südlichen Ländern der *EWG* besteht ein reger Kartoffelhandel. Der Verfasser sieht grosse Vorteile in unbehindertem Handel und weist auf andere Verwendungsmöglichkeiten der Kartoffel hin, die noch nicht voll erprobt wurden.

Gesichtspunkte der Saatbettbereitung und des Kartoffellegens

G. J. Poesse, U. D. Perdok, E. Strooker

EINE zweckmässige Bodenbearbeitung für Kartoffeln hängt davon ab, ob man eine lockere, feuchte, krümmelreiche Schicht von etwa 100 mm Tiefe herstellen kann, welche in einen Damm von 250 mm Höhe und 500 mm Breite aufgebaut werden kann. Die für diesen Zweck verwendete Methode hängt von der Bodenart ab, wobei sandige Böden wenig Probleme schaffen. Schwerere Böden dagegen benötigen eine Frosttätigkeit und die Verwendung von Kultivatoren bzw. Fräsen. Der Feuchtigkeitsgehalt des Dammes muss erhalten bleiben, sodass die Bodenbearbeitung und das Legen der Kartoffeln schnell durchgeführt werden sollten.

→ *page 10*

Kartoffellegemaschinen sollen das Saatgut in geraden Reihen in gleichmässiger Tiefe und bei gleichem Abstand ablegen. Die Vorkeimung ist wichtig, vorallem bei der Saatkartoffelproduktion. Legemaschinen, welche vorgekeimtes Saatgut mit geringster Beschädigung einlegen, haben eine langsame Arbeitsweise. Abänderungen an vollautomatischen Legemaschinen, um etwaige Keimbeschädigung zu verringern, vermindern auch die Arbeitsleistung. Ein System mit zwangsloser Einlegung verursacht wenig Beschädigungen, die Ablegeregelmässigkeit wird aber auch vermindert und weitere Arbeit ist erforderlich.

Die Vernichtung des Krautes ist notwendig, um Virusinfektionen in Saatkulturen oder die Infektion der Knollen durch Phytophtora, zu verhindern, und um die Rodearbeit zu erleichtern. Chemische Methoden sind heutzutage weit verbreitet, verunreinigen aber den Boden. Abbrennen und Abdämpfen wurden versucht, diese Methoden sind aber mit hohen Kosten verbunden und verunreinigen die Luft. Mechanische Methoden scheinen für die Zukunft den grössten Erfolg zu versprechen.

Gesichtspunkte der Saatbettbereitung und des Kartoffellegens

F. E. Shotton

Bodenbearbeitung

VIELE der in Grossbritannien verwendeten Anbaumethoden haben ihren Ursprung in Holland, besonders aber die Auffassung, dass der Zweck der Bodenbearbeitung nicht nur die Produktion einer guten Kultur ist, sondern auch eine Erleichterung der maschinellen Ernte, mit verringerter Handarbeit zum Sortieren.

Böden im Osten Englands, die mehr also 30% Lehm enthalten, bereiten Schwierigkeiten wegen des geringen Eindringens des Frostes, der plastischen, oberflächennahen Bodenschichten und des durch die Schlepperreifen verursachten Bodendruckes.

Frühe Versuche mit Eggen führten zu grösserer Bodenlockerung zwischen den Reihen, verringerten aber den Ertrag. Tiefere Bearbeitung hatte grössere Klutenbildung und tiefliegende Knollen zur Folge. Chemische Unkrautbekämpfung hatte unter diesen Bedingungen bestimmte Vorteile. Auf Schluffböden bereiten grüne Knollen Schwierigkeiten, die durch die Bodenverkrustung mit darauffolgender Rissbildung auf der Oberfläche verursacht werden. Dies wird durch grössere Dämme verringert.

Gips (Kalziumsulfat) kann die Klutenbildung vermindern. Rotierende Werkzeuge sind erfolgversprechend, breitere Reihen erfordern weniger tiefe Bodenbearbeitung und ermöglichen schnelleres Roden.

Kartoffellegen

Vorkeimung erhöht den Ertrag um 35 dz/ha. 15 mm ist die optimale Länge und die während einer längeren Zeitspanne gebildeten Keime sind widerstandsiähiger. Maschinen mit Handeinlegung beschädigen die Knollen weniger als automatische.

Sehr unregelmässige Ablage der Knollen kann den markttähigen Ertrag verringern. Höhere Arbeitsgeschwindigkeiten der Legemaschine beeinflussen mehrere andere Faktoren und man sollte weitere Versuchsarbeiten durchführen, um ein System zu entwickeln, welches den höchsten Gewinn und nicht unbedingt den höchsten Ertrag erzielt.

Neueste Entwicklungen der Kartoffel–Sammelroder

D. C. McRae

DIE Einführung einer praktischen Röntgenstrahlen-Ausleseeinrichtung stellte einen Wendepunkt dar, sodass weitere Fortschritte in der Konstruktion wesentlich von der Entwicklung dieses Systems abhängen werden.

Verschiedene Methoden der Gammabestrahlung werden untersucht und Wirkungsgrade von 94-96% konnten damit erzielt werden. Die Bestrahlung unterdrückt die Keimbildung und der Schutz der Arbeitskräfte ist auch wichtig, gefährliche Strahlungspegel sind aber unwahrscheinlich. Scheinbar wird ein solches System in einem Roder eingebaut billiger als ein elektronisches System sein.

Acht prozent der schweren Beschädigung wird während des Transportes und Umladens vom Sammelroder zur Lagerungsstelle verursacht. Eine Untersuchung hat gezeigt, dass die Knollen in vielen Fällen von einer Höhe von mehr also 470 mm abgeworfen wurden, d.h. einer Höhe bei der Knollenbeschädigungen eintreten. Versuche mit einem in der Höhe einstellbaren Lader, der mit einem Fühler ausgerüstet ist, haben zu einer wesentlichen Verminderung der Beschädigungen geführt.

Leistungsprüfung von Kartoffelroder–Systemen

I. Rutherford

EINE gemeinsame *ADAS/PMB* Untersuchung wurde 1971 mit 30 Modellen von Sammelrodern in verschiedenen Teilen Englands durchgeführt. Die Feldleistung von 8 Maschinentypen wurde auf 192 landw. Betrieben bestimmt. Angaben über die langfristigen Arbeitsleistungen von 249 Maschinen wurden auf Karteikarten aufgenommen. Rodeverluste, Knollenbeschädigung und der Gehalt an Beimengungen wurden gemessen.

Die wesentlichsten Ergebnisse dieser Untersuchung waren:

1. Die potentielle Maschinenleistung war ausreichend, wurde aber auf vielen Betrieben nicht voll ausgenützt.
2. Der Transport vom Feld verringerte die Leistung der Rodemaschine in vielen Systemen mit potentiell hoher Arbeitsfähigkeit.
3. Bei den meisten Maschinen betrugen die Rodeverluste 12·5 dz/ha, was zusammen mit einem Verlust an beschädigten Knollen von 5%, für viele Betriebe einen finanziellen Verlust von etwa £62/ha darstellt.

A Survey of European Production of Sugar Beet*

by J. Jorritsma†

IT is complicated to prepare an up to date survey of European production of sugar beet. I learned this after I had accepted the invitation to give the opening paper on the occasion of this Conference.

I asked the help of some friends and colleagues in six western continental European countries which was granted in abundance and I am very grateful to them for their friendly collaboration.

Sugar is a product of great importance as a nutritious substance: sweet, pure and full of energy.

No wonder that sugar has always been regarded to be of great social and therefore of political importance.

Napoleon afraid of being cut off from his cane sugar supply ordered in 1802 that all European countries under his influence should grow beet since these plants had been shown suitable for the extraction of sugar.

Although this first attempt did not prove to be a success, a second one a bit more than 100 years ago was more successful and led to the present situation: a flourishing sugar beet growing industry to supply this basic material for sugar production.

So the fact that there is any sugar production on the continent and that I am standing here to give this survey is due to the ancestors of the majority of todays audience.

Since most governments want to safeguard sugar production to the level of home consumption, sugar beet growing and sugar production is protected. This not only means guarantees for government and consumer but also for the grower of the basic material: sugar beet.

Sugar beet in many countries is a crop that decides the financial stability of the farm. Sugar is also a comon source of tax and helps to fill the treasury.

This means that only surpluses are brought to the world market. So this world market is a real dumping market. World market prices are very sensitive to surplus or shortage. At the moment the surplus, difference between consumption and production, seems to be diminishing and therefore world market prices are going up, be it in a somewhat feverish way.

In this connection it is also important to realise that there is a positive correlation between standard of living and sugar consumption per head. As both number of heads and standard of living are still increasing there will be a growing need for sugar.

For the time being there is no alternative to the use of sugar beet as basic material for the production of sugar, syrup and some alcohol.

There is no sense in growing sugar beet without being sure that they can be processed by some factory. This means that there always is some kind of contract betwen farmer and manufacturer in which rights and duties of both parties are recorded.

Both manufacturer and grower are involved in the same process of sugar production and should aim at the most profitable result: the farmer by growing a maximum of basic material of optimal quality, the manufacturer by optimal extraction at the lowest cost.

As sucrose is the final product wanted, the grower should be paid after the amount of sucrose that can be extracted from the basic material delivered by him is determined as well as after the cost of processing of this material.

These observations made by the way of an introduction are meant to define the character of sugar beet growing as part of the process called sugar production.

Looking now at the continental western European countries, Belgium, Denmark, France, German Federal Republic, the Netherlands and Sweden, we find from Table 1 that apart from Denmark and Sweden where home sugar production was limited to home sugar consumption or even less all countries show an increase of acreage that is stil going on.

Table 1 *(page 14)*

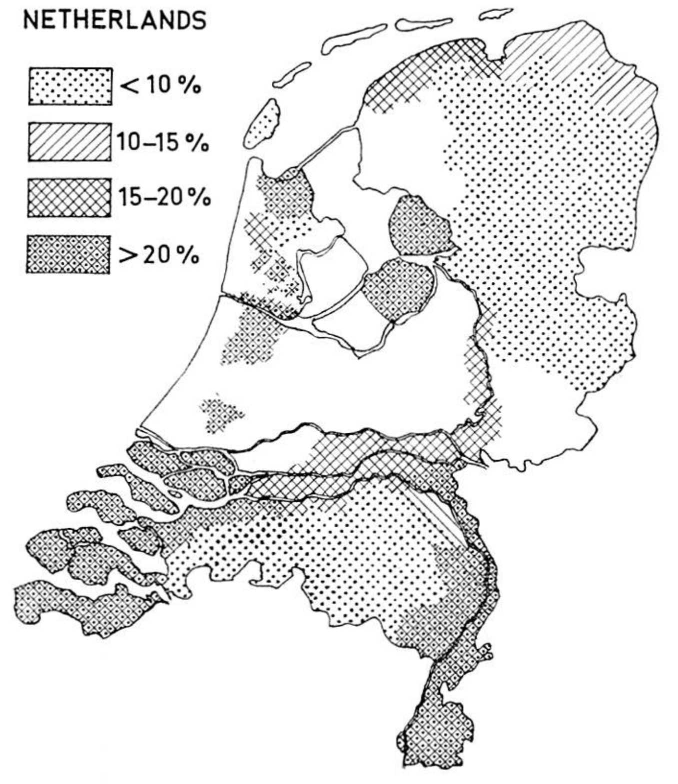
The maps give details of the beet growing areas in each country. These main areas are situated on the loess soils of North West Germany, Belgium and France.

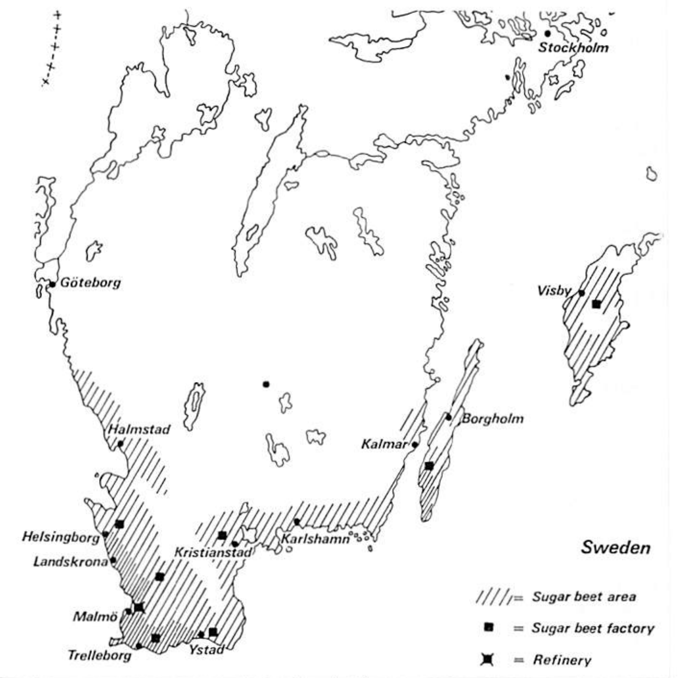
Table 2 gives an idea of the main soil types in so far as lack of uniformity of classification and the difficulties of translation allow and shows that the soils used in addition to the loess type are of glacial origin in Sweden and Denmark and alluvial soil in the Netherlands.

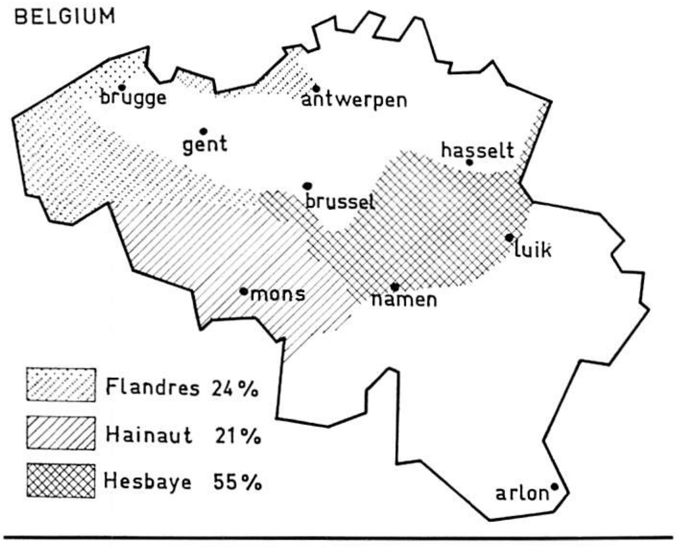
Table 2 *(page 14)*

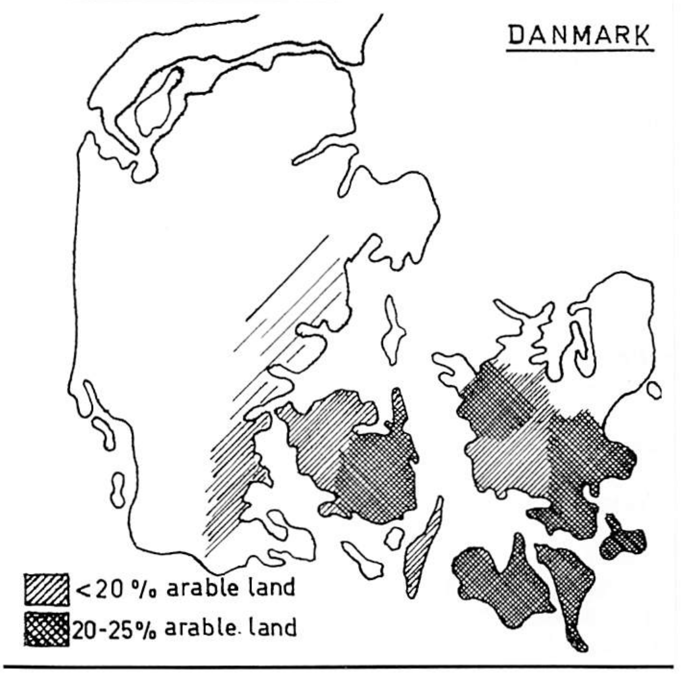
** Presented at the Commission Internationale du Genie Rural and the Institution of Agricultural Engineers Joint Autumn National Meeting at the National College of Agricultural Engineering, Silsoe, Bedfordshire, on 2 October 1972.*

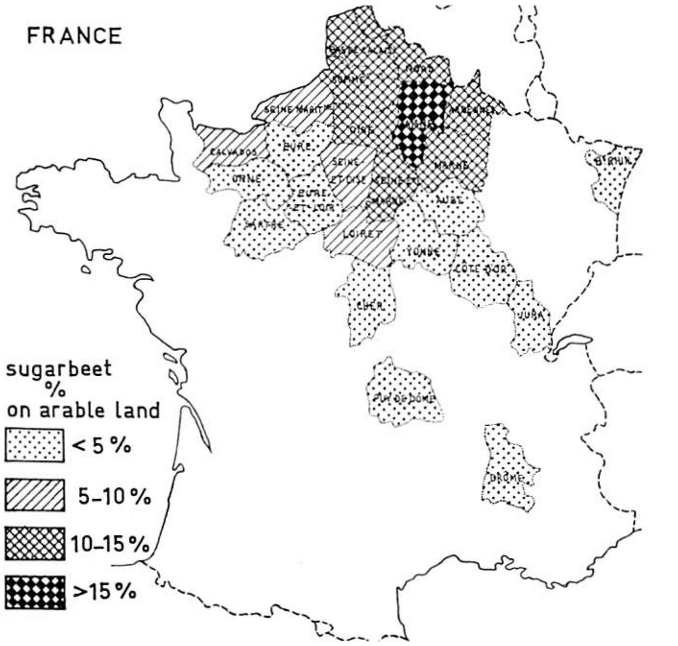
† Institut voor Rationale Suiker Productie, Bergen op Zoom, Netherlands.


NETHERLANDS
< 10 %
10–15 %
15–20 %
> 20 %


Stockholm
Göteborg
Visby
Halmstad
Borgholm
Kalmar
Helsingborg
Landskrona
Kristianstad
Karlshamn
Malmö
Trelleborg
Ystad
Sweden
//// = Sugar beet area
■ = Sugar beet factory
= Refinery


BELGIUM
brugge
antwerpen
gent
hasselt
brussel
luik
mons
namen
arlon
Flandres 24 %
Hainaut 21 %
Hesbaye 55 %


DANMARK
< 20 % arable land
20-25 % arable land


FRANCE
sugarbeet
%
on arable land
< 5 %
5–10 %
10–15 %
>15 %

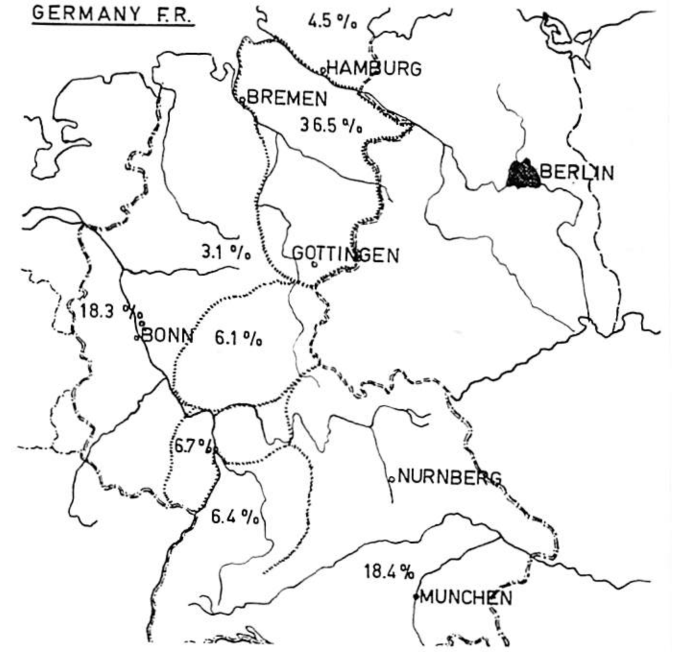

GERMANY F.R.
4.5 %
HAMBURG
BREMEN
36.5 %
BERLIN
3.1 %
GOTTINGEN
18.3 %
BONN
6.1 %
6.7 %
NURNBERG
6.4 %
18.4 %
MUNCHEN

Table 1

Sugar Beet Acreage x 1000 ha

	Belgium	*Denmark*	*France*	*German FR*	*Netherlands*	*Sweden*
1950	62·6	69·7	408·7	184·0	66·9	54·4
1955	57·4	54·0	377·6	263·7	66·8	52·5
1960	63·0	50·5	422·3	299·2	92·5	50·7
1965	65·4	56·0	392·7	293·2	91·9	41·7
1968	89·5	50·7	393·6	302·1	103·5	41·5
1969	89·9	50·7	396·7	309·5	102·9	40·4
1970	89·7	47·3	400·0	311·3	104·5	39·5
1971	93·1	51·0	419·2	318·0	102·3	40·9
1972 (est.)	100·3	57·0	450·0	328·0	113·0	41·2

Table 2

Sugar Beet Growing and Soil Type

Belgium		*Denmark*			*France*	
Poldersoil	5 per cent	Recent	fine text.	40 per cent	Loess	70 per cent
Loess	72 per cent	Glacial	med. + text.	35 per cent	Rendzina	20 per cent
Sandy loess	23 per cent	Till	med. — text.	25 per cent	Sandy loess	10 per cent

German FR		*Netherlands*		*Sweden*	
Loess fine text.	20 per cent	Alluvial mar. and fluv.	72 per cent	Sandy silt loam	14 per cent
Loess med. text.	72 per cent	Loess	3 per cent	Sandy clay loam	19 per cent
Sandy soil	8 per cent	Plaggensoil	20 per cent	Sandy loam	41 per cent
		Highmoor reclamation with sandy top	5 per cent	Loamy sand	26 per cent

Sprinkler irrigation on any scale is only practised in some parts of France and Germany on light soils in low rainfall areas.

The basic conditions for proper sugar beet growing are a fertile soil with good structure and a relatively high pH which does not easily suffer from excess of water or drought.

Tables 4 to 9 inclusive show in which acreage units sugar beet is grown in the six countries. The comparison is not always easy as the categories differ not only in type but also in number.

Belgium

The general shift in acreage per farm is quite clear. Although the decrease in number of growers in 1967 as compared with 1950 is not very great.

Table 3

Average Acreage per Grower

Belgium	1959	1·6 ha	(4·0 acres)
	1971	2·9 ha	(7·3 acres)
Denmark	1960	2·4 ha	(6·0 acres)
	1972	4·1 ha	(10·3 acres)
France	1956	3.0 ha	(7·4 acres)
	1964	4·6 ha	(11·5 acres)
German FR	1960	1·6 ha	(4·0 acres)
	1971	2·5 ha	(6·3 acres)
Netherlands	1959	1·5 ha	(3·8 acres)
	1970	3·1 ha	(7·8 acres)
Sweden	1962	2·2 ha	(5·5 acres)
	1972	3·3 ha	(8·3 acres)

Table 3 shows the current average acreage per grower for the six countries, in comparison with a historical figure.

It is really striking how much these averages have changed in the last ten years. The most recent figure I obtained from France is from 1964 so it may be assumed that the average acreage is now considerably higher. The advantage of a large acreage in large fields as we know there are in northern France must not be underestimated.

The great change has occurred later on.

The average percentage of sugar beet on total arable soil in 1972 is 13·3. Cereals take 61 per cent forage crops (fodder beet included) 11 per cent and potatoes 4·8 per cent.

Denmark

On farms with arable land only 25 to 30 per cent of the acreage is in sugar beet. The rest is mainly wheat and barley. With mixed farming 10 to 25

Table 4

Belgium

Sugar Beet Acreage per Farm

	1950		*1967*	
	Number per cent	*Acreage per cent*	*Number per cent*	*Acreage per cent*
< 1 ha	54·4	16·5	32·7	8·0
1 - 3 ha	34·6	36·2	46·6	36·1
3 - 5 ha	6·2	14·6	12·5	20·8
5 - 10 ha	3·4	14·2	5·8	17·0
10 - 20 ha	1·1	12·1	1·8	10·6
20 - 30 ha	0·2	3·7	0·4	3·8
> 30 ha	0·1	2·7	0·2	3·7
	100 = 40072	100 = 62260 ha	100 = 37478	100 = 77653 ha

Table 5

Denmark

Sugar Beet Acreage per Farm

	1960 Number per cent	*1960* Acreage per cent	*1972* Number per cent	*1972* Acreage per cent
< 1 ha			23·5	3·8
1 - 5 ha			55·4	34·1
5 - 10 ha			13·8	23·4
10 - 20 ha			5·5	18·8
20 - 50 ha			1·7	12·6
> 50 ha			0·4	7·3
	21000	50500 ha	100 = 14079	100 = 57000 ha

per cent of the arable land is occupied by sugar beet, the remaining by fodder beet grass and barley.

On the farms where sugar beet are grown, the Part taken by sugar beet varies from 14-25 per cent.

France

Table 6

Sugar Beet Acreage per Farm

	1956 Number per cent	*1956* Acreage per cent	*1964* Number per cent	*1964* Acreage per cent
< 5 ha	86·3	35·6	78·3	-
5 - 10 ha	8·2	16·4	12·0	-
10 - 20 ha	3·2	16·4	5·7	-
20 - 50 ha	1·8	19·3	3·1	-
> 50 ha	0·5	12·3	0·9	-
	100 = 122800	100 = 365000 ha	100 = 86350	100 = ± 393000 ha

As in 1964 78 per cent of the farms still had a sugar beet acreage smaller than 5 ha (14 acres) and the lowest category 0-5 ha (1 acre) was not subdivided this table does not give a clear picture of the situation.

The part with sugar beet varies from 8-25 per cent whereas the other crops are mainly cereals, in some regions potatoes, in other regions maize.

The other crops are mainly cereals (wheat, rye, barley and maize).

Netherlands

The category <5 ha (12 acres) is subdivided into five categories. In total 80 per cent of the farmers grow 5 ha (12 acres) of sugar beet or less. The percentage of the arable land grown with sugar beet varies from 20-25 per cent on the alluvial soils in the south-west, west, and Zuidersee reclamations, down

Germany

Table 7

Sugar Beet Acreage per Farm

	1960 Number per cent	*1971* Number per cent	*1971* Acreage per cent
0 - 5	94	90	56·6
5 - 10	4	7	17·2
> 10	2	3	26·2
	100 = 181500	100 = 125700	100 = 318000 ha

The same is true for Germany where in 1971 90 per cent of the farms still have a sugar beet acreage smaller than 5 ha (12 acres).

Table 8

Netherlands

Sugar Beet Acreage per Farm

	1959 Number per cent	*1959* Acreage per cent	*1970* Number per cent	*1970* Acreage per cent
< 1 ha	55	16	23	4
1 - 2 ha	22	19	27	12
2 - 3 ha	9	13	15	11
3 - 4 ha	5	10	9	9
4 - 5 ha	3	8	6	8
5 - 10 ha	5	23	14	31
> 10 ha	1	11	6	25
	100 = 59946	100 = 92981 ha	100 = 33212	100 = 103861 ha

to 5 per cent on the sandy and peaty soils with an exception for a sandy district in the south east where the percentage is as high as 24.

Besides sugar beet, potatoes are a very important crop from 15 to 30 per cent on alluvial soils up to more than 50 per cent on sandy and peaty soils. The remaining part is occupied by cereals and in some districts peas, beans, flax and winter rape.

Sweden

Table 9

	1962		1972	
	Number per cent	*Acreage per cent*	*Number per cent*	*Acreage per cent*
< 1 ha	36·4	8·4	21·4	3·9
1 - 4	49·6	43·2	52·2	33·3
4 - 8	10·6	25·9	18·9	31·0
8 - 12	2·0	8·8	4·5	12·9
12 - 20	0·9	5·8	2·1	9·3
> 20	0·5	7·9	0·9	9·6
	100 = 21700	100 = 47210 ha	100 = 12600	100 = 41450 ha

Here too, about 80 per cent of the farmers grow 5 ha (12 acres) of sugar beet or less. Further important crops are cereals and winter rape.

Summarising, it can be said that perhaps with an exception for France, 80 per cent of the farms in western Europe grow 5 ha (12 acres) of sugar beet or less.

Although I would like to go into details with regard to the techniques of sugar beet growing. I will resist that inclination as I know that my colleagues Dr Martens and Professor Brinkmann will do so in their papers.

Perhaps I might point out a few facts which they may omit, which might be of interest to you.

In all six countries the great majority of varieties used for a long time are of the polyploid type (triploids included). The rubbed and graded or technical monogerm seed of these varieties had already a high "natural" monogermity. The use of genetical monogerm varieties has increased in the course of the last years but in a variable way as indicated by the 1972 percentage use given below.

	per cent		*per cent*
Belgium	4·3	Germany FR	30
Denmark	15	Netherlands	36
France	20+	Sweden	100

Whereas some countries apparently prefer pelleted seed even of multigerm varieties others don't as indicated by the following 1972 percentage figures:

	per cent		*per cent*
Belgium	11	Germany FR	66
Denmark	80	Netherlands	2
France	33	Sweden	30

As far as weed control is concerned it may be mentioned that in some countries beet and/or potatoes are becoming a nuisance.

The first arise from seed which falls from bolters which, for some reason or another, occurred in a previous beet crop. The potatoes because the "fall out" did not die in the winter after the potato crop.

Finally, and now we are back at the agricultural structure again, there is the part of the machine work that is done by contractors.

Contractors play an important role in some countries. The amount of machine work undertaken by contractors in 1972 is shown below:

	per cent		*per cent*
Belgium	70	Germany FR	10 - 20
Denmark	20	Netherlands	75
France	30	Sweden	50

In some countries eg Denmark and Germany *FR* some machines are collective property.

After all this it might be interesting to know what the yields are in the respective countries.

Table 10 *(page 17)*

In most countries there is a slight tendency of increasing yields most apparent for France and Germany.

Table 10 — **Sugar Beet Yield t/ha**

	Belgium	Denmark	France	Germany FR	Netherlands	Sweden
1950	42·7	35·6	33·1	36·1	43·6	36·4
1955	39·1	33·4	29·2	33·2	46·1	31·6
1960	48·7	43·1	46·2	42·8	53·9	47·7
1965	35·8	29·0	43·0	35·6	40·5	32·1
1968	45·9	44·2	43·2	46·0	50·8	47·8
1969	46·9	37·9	44·1	42·7	50·3	36·4
1970	43·1	40·0	43·0	42·7	46·4	39·5
1971	52·3	40·8	48·5	45·5	51·5	41·7

Another important feature is the sugar content.

Table 11 — **Sugar Content per cent**

	Belgium	Denmark	France	Germany FR	Netherlands	Sweden
1950	16·1	16·1	17·0	16·0	15·9	16·9
1955	16·5	16·1	17·9	15·9	15·6	15·8
1960	15·9	16·3	16·7	16·1	15·5	16·4
1965	16·5	16·0	17·0	15·8	16·8	16·3
1968	14·8	16·4	15·9	15·0	14·9	16·5
1969	15·9	17·3	17·4	16·3	16·0	16·3
1970	15·9	16·7	17·4	16·1	15·8	16·1
1971	16·8	17·3	17·4	17·0	16·8	17·2

Finally, I tried to collect some data on tare percentage which however were not supplied by all countries. From those figures obtained I concluded that there has been no visible increase of tare percentages since 1950.

Now this may be due either to the fact that the tare did not increase or to lower standards in the tarehouse. Belgium, Denmark, the Netherlands and Sweden produced these figures and these countries differ widely, at least officially, as far as these standards are concerned.

The differences mainly concern the standard of topping. In most countries the way of topping in practice has changed considerably since defoliates are used but also when topping is done by some topping equipment. In some countries the factory 'kick back' by sending bad quality loads back to the farm.

In all cases leaves and the upper part of the crown are cut off in the tare house. In some countries (eg France) beet are received with most of the crowns and some petioles. In the tare house however these parts, leaves and complete crown, are removed carefully and go to the tare.

The lowest level of this cut is just above the lowest leafscar so that this scar is still visible on the beet whereas the concentric vascular rings may not become visible. In this respect the use of the tops is also of influence.

Table 12 — **Use of Sugar Beet Tops per cent Acreage**

	Belgium	Denmark	France	Germany FR	Netherlands	Sweden
For feeding fresh	18	10	5	16	24	20
silage	52	55	5	64	36	50
Ploughed in	30	35	90	20	40	30

It appears from Table 12 that most of the tops with an exception for France are used for cattle feeding (60-80 per cent) mainly as silage. Only in the Netherlands are part of the tops used on farms other than that on which the beet was grown.

With regard to the periods in which the beet are harvested and processed the results of an enquiry held by Martens and Oldfield together with the data I collected show that the harvesting period is about the same for all countries: 55-65 days depending on the total yield.

The most desirable deadline for harvesting is fixed at 15 November. The processing period varies from 70 to 75 days for Belgium, Denmark, and Sweden, to 80 to 85 days for France and the Netherlands whereas in Germany the period is somewhat longer. In every country an attempt is made to finish the campaign before Christmas. All this is a matter of climate, soil and method of transport. It follows from this that at least part of the beet has to be stored in clamps often at the farm on the yard or on the headlands, sometimes in factory yards or delivery centres. Artificial cooling by blowing cool air through the clamp is only done in the south of Germany.

Table 13 *(page 18)*

Table 13 lists data supplied by the six countries regarding labour and cost. The first part shows how the number of seeds/metre decreased generally in comparison to 1950. Martens will without doubt discuss the present seed distances. Singling and cleaning takes much less time than 20 years ago. The frequency of inter row machine hoeings decreased. The degree of mechanisation of the harvesting operation is really striking. Differences are

Table 13

	Belgium		Denmark		France		Germany FR		Netherlands		Sweden	
	1950	*1971*	*1950*	*1971*	*1950*	*1971*	*1950*	*1971*	*1950*	*1971*	*1950*	*1971*
Number seeds/m	35	11- 7	35	15	35	11- 7	50	15	35	12	35	14- 6
Singling/cleaning m/h ha	91	33-10	88	35	85	20	200	60	115	25	121	37
Frcq. interrow hoeing	3 to 4x	1 to 2x	3 to 4x	2 to 3x	-	-	2 to 3x	0 to 1x	4x	2x	4x	2x
Harvesting m/h ha	193	7	165	35	130	15	360	45	230	10	139	12
Seed cost Dfl/ha	20	98/77	20	113	-	110/80	40	111	20	115	-	-
Herbicide cost Dfl/ha	-	210	-	180	-	107/119	-	167	-	200	-	218
Cost m/h Dfl	1·20	4·80	0·95	6·30	-	3·75	0·64	3·73	0·75	6·50	1·20	10·29

Dfl = guilders. Current exchange rate 8 guilders = £1 (approx)

mainly due to the question of whether top harvesting is included or not.

The determination of costs of production is always a difficult matter, obscured by taxes and subsidies. The table shows a few items which changed considerably in the course of the last 20 years. Although less seeds are used the seed cost has increased considerably, it is still a minor part of the total growing cost.

Herbicides were not used 20 years ago. Nowadays they have to be used and paid for. The cost depends on the intensity and on the way of application: band or overall. The cost of a man hour varies more than is often supposed and increased considerably since 1950. But again, these figures have to be regarded with some reserve.

As I said before, all sugar beet are grown on contracts with the sugar factories. The conditions of which are minutely described and differ from one country to another.

It is a matter of agreement between parties involved. Items such as time and way of delivery, transport cost, quality requirements, sampling, weight and quality determination, prices and premiums, way of payment, pulp etc are described in the contracts.

In some countries the sugar beet delivered should be grown from seed supplied by the factory (Denmark, Sweden), in other countries the growers are allowed to buy the seed themselves when only it is seed of a certified sugar beet variety (Belgium, France) A third possibility is that seed is supplied by the factory of a variety, or of varieties freely chosen from an official sugar beet variety list by the grower (Netherlands, Germany).

A fact worth mentioning is that no sugar industry in the six countries is under direct control of the government.

As for the countries belonging to the Common Market the price is fixed at Brussels: 17 units of calculation for the allocated quotum, 10 units of calculation for the beet between 100 and 135 per cent of the quotum and over that, world market price. Sometimes (Netherlands) a mixed price system is accepted over a number of years. This basic price holds for a product with a sugar content of 16 per cent. Every 0·1 per cent more or less means an increase or decrease by 0·9 per cent of the basic price. In Denmark the price was always relatively low, but has increased since 1960 (=100 per cent) up to 173 per cent in 1972.

In Sweden the level is comparable to that in the Common Market.

As far as the legal form of the sugar industry in the various countries is concerned:

Belgium knows only the company *(Societe Anonyme)*.

Denmark has one company with five factories processing 86 per cent of the beet and one co-operative. There is a fixed price for beet from which sugar for home consumption is extracted whereas the surplus is sold on the world market. The price the farmer gets paid is a mixed one.

France has 77 sugar factories, mainly companies but 11 where the farmers are shareholders which means a kind of co-operative.

The individual growers quotum is based on their production in the period 1961-1965; 65-70 per cent of the beet are delivered on base of the system called *pesee geometrique*. That means that the yield is determined by sampling of the field before harvesting and is received at the same time by the factory. The beet are stored on the headlands and transported by the factory. The other part has to be delivered by the growers, to the reception centres before 25 November.

The **German** sugar industry is also mainly companies, sometimes with limited liability and some co-operatives, in total 58 sugar factories.

The **Netherlands** have 12 sugar factories, six *Centrale Suiker Maatschappij* and six *Suiker Unie*. The latter processes 62 per cent of the beet and has a co-operative structure. Not only that, growers are the only shareholders but a share means also the obligation to deliver a minimum of beet and the right to deliver a maximum. Typical for the Netherlands is the transport in barges although the percentage decreases as the transport by lorries increases.

The sugar industry in **Sweden** is a company owned by a great many shareholders. Swedish sugar production is limited at the moment to only 65 per cent of home consumption. The seed cost is included in the beet price. The growers are allowed to use up to 16 seeds/m.

Seventy-five per cent of beet transport is done by tractor, 25 per cent by lorry.

Developments In The Mechanisation Of Soil Preparation And The Establishment Of The Sugar Beet Crop*

by M. Martens†

IN this paper I wish to look at the present stage of sugar beet mechanisation and to make some observations on the way it may progress.

Mechanisation has reached a stage where further economy in manpower is difficult to achieve. The spring and autumn labour peaks which were troublesome have been markedly reduced and the remaining manual labour that is used in Spring requires further advances in seed quality and weed control techniques for its reduction. In Autumn high capacity harvesting techniques are being used and automatic control of equipment in making progress.

Mechanisation, however, has a large contribution to make in the production of more sugar from existing crops. In the past mechanisation was supposed to lower output when compared with hand methods but in all European countries over the last 20 years the yield of sugar has risen at about 100 kg/ha/a. A 40 per cent rise in output over 1950 figures.

Yield is closely linked with the date of sowing in most climatic conditions. Taking Belgium as an example, sowings before 10 April yield an average 864 kilos of white sugar/ha more than sowings after that date. Carrying this a little further by taking three sowing periods it is surprising to see that sowings in March show returns of 14 per cent more than those between 1 and 15 April and 29 per cent more than sowings after 15 April. Few factors influence output more than the length of the growth period. Neither manuring nor plant population have such a marked effect.

Similar trends are noticeable at harvest time since the sugar beet plant is harvested when it is in full production. Between 20 September and 20 October the increases of sugar/ha are similar to that during August. These increases are again of the order of 100 kg/ha/d of white sugar during harvesting.

On the continent where the harvest period ends earlier than in *UK* it will obviously be very worthwhile to study techniques which will enable us to sow earlier and to harvest later particularly by the synchronisation of lifting and transport. This is certainly our view in Belgium, with its variable spring weather when planting, which can start and then be held up for ten or even 20 days. The year 1970 was such a season when most sowing was held up until early May and loss of yield was estimated at 1,000 kg/ha of sugar. A method of planting when the soil is moist on the surface is required. On many occasions soil conditions can be described as bad at 08 00 h. and good at noon when only the most superficial drying has taken place in the morning. This drying is required to increase the structural stability of the ground after sowing.

After 15 March soil temperatures are normally high enough for growth. Frost is not a great problem, in fact it may be a greater problem later on because of the greater temperature differences between day and night.

Power harrows have been used in Belgium in order to try to find out the limiting conditions for sugar beet planting.

The planters immediately follow the harrows so that work can be stopped at any time the rain comes. The problem is that many of the power harrows available at present reciprocate too quickly and destroy structure. Many growers in Belgium have adopted a system similar to this and in five years out of six they are finishing sowing when the others are just going out to spread fertiliser.

In the course of our trials we compared the temperature and moisture content in the seedbed in traditionaly bad conditions and in good with a dry surface. We were surprised that at sowing depth the temperatures were very similar, the only difference was in moisture content at the surface.

It is possible of course, to artificially protect the structure of the soil surface from capping and moisture loss by protective coverings, by-products of the petro chemical industry, and trials are taking place in several countries. At the present stage the price of these products cannot be related to the sugar beet crop but if they were used on a large scale they could become very cheap.

* *Presented at the Commission Internationale du Genie Rural and the Institution of Agricultural Engineers Joint Autumn National Meeting at the National College of Agricultural Engineering, Silsoe, Bedfordshire, on 2 October 1972.*

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There is no doubt that we shall have to change our ideas on fertiliser application if new ideas are applied to planting. Most fertiliser is spread in Spring just prior to planting and the soil must be in good condition to allow the heavy spreaders over the soil without too much damage. Farmers adopting early drilling techniques generally apply fertiliser in January thus separating it from drilling. Researchers are not agreed among themselves on the amount or importance of nutrient losses which probably means they are not very significant when compared with the advantages of early drilling in the improved yield and juice quality.

In some factories in Belgium the quality of juice has been dropping over the past few years but this perhaps is outside our terms of reference.

There is another method of increasing the return on the crop through mechanisation at the harvest time. What is required is to shorten the harvest season by the synchronisation of lifting and loading and then to start the harvest later. In fact in Belgium this year the industry have decided to delay the factory opening by ten to 15 days and to start on 8 October. This will represent about 87 kg/ha/d of white sugar, a large quantity of sugar nationally. In the course of an enquiry in which I was engaged two years ago, we found that there was an average difference of 15 days between lifting and transport to the factory which could represent growing time.

There has been a great development in equipment which will allow us to harvest 6 or 8 ha/d so we can think in terms of integrated lifting and transport planned either by the factory or the large growers in co-operation with the factory.

The new concept of integrated lifting and transport will be very difficult to operate with individual farmers owning their own harvesters and transport. There will be a move to large scale combines because the cost especially of the loading and transport operation, is very great representing an investment of Fr 7m (Belgian) (£50,000) for five or six 15 ton trucks and a hydraulic crane with an output of 400 t/d of roots or 20,000 t/season. This forms a convenient unit matching the output of a six row harvesting machine. The harvesting equipment represents an investment of Fr ½m (Belgian) (£3,500) plus part of the value of the tractors making a total of more than Fr 1m (£7,000). It can be seen that the problem is one of high investment in loading and transport and to lower this cost is of great importance. At present the farmer with high capacity harvesters must adjust his harvesting rate to coincide with the rate of work of the transport. It is important that harvesting mechanisation is dealt with as an integrated system which includes transport and that the study of the transport element will be much more important than comparisons of either performance or price of lifters.

by D. R. Brisbourne NDA†

Opening Remarks

SUGAR beet growing in the United Kingdom has undergone a considerable change during the last few years. The major developments have been with regard to seed, seed spacings and herbicides. These factors, more than any others, have enabled the British grower finally to consider growing his crop of sugar beet with little or no hand labour. In 1971/72 there were 262 growers who grew their entire crop without resorting to hand labour, and this constituted 2·1 per cent (3,817 ha [9,436 acres]) of the total acreage grown for the British Sugar Corporation. In addition to this, of course, there were many growers who grew part of their contracted acreage without the use of hand labour, and if this acreage also was to be included then approximately 8 per cent (15,176 ha [37,500 acres]) of the total acreage in this country has been grown in this way. To clarify the expression 'drilling to stand', as far as the United Kingdom grower is concerned, any initial seed spacing of 12·7 cm (5 in) or over constitutes a drilled to stand crop.

Why has there been this rapid change to drilling to stand with little or no hand work? The answer is rather complex, but the main reasons are, undoubtedly a shortage of hand labour in certain areas, improvement in the quality of monogerm seed, and an increase in the availability of herbicides for use on the sugar beet crop.

There are certain areas in this country where drilling to a stand is not possible, or is not desired. In the eastern part of Britain there is still a reasonable availability of farm workers who look upon hand-hoeing of the beet crop as means of earning extra money, and employers who consider that the hand-hoed crops give them a better yield and better return. The farm labourer is also kept occupied at a time of the year when there is little else for him to do. There is also some casual labour close at hand which can be used for singling purposes. Although I think this situation will alter in the not too distant future, at the present time growers in these areas must think in terms of a suitable crop for subsequent hand work. In this respect it is generally agreed that, where complete hand-singling is to take place, 7·6 cm (3 in) spacing of a monogerm or polyploid variety is most suitable, these two seeds giving a high number of single plants. This spacing ensures a final crop of approximately 30,000 plants per acre, and yet does not provide a forest of plants for the hoeman to tackle. Wider spacings than 7·6 cm (3 in) ie 10·2 cm or 12·7 cm (4 in or 5 in), cause problems to the growers when hand-hoeing time approaches. Very often there are not sufficient plants to enable every other one to be removed, and yet if no handwork is put into the crop too many plants result.

In the west of the country there is a real shortage of labour and here drilling to a stand is being done on a considerable scale. In one factory area over 50 per cent of the total factory acreage is drilled at

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12·7 cm (5 in) spacing and upwards. In this situation the growers appear to have standardised at 15·2 cm (6 in) spacing as being the most suitable for drilling to stand techniques. Under normal conditions, even at best, we can only hope to achieve approximately 65 per cent field emergence, and therefore in these western regions where rainfall is slightly higher than the national average, and the climate is a little less severe, this 15·2 cm (6 in) spacing results in a final plant stand somewhere near the optimum. Wider spacings than 15·2 cm (6 in) even under those conditions, constitute a real risk of a below-standard final plant stand.

There facts are borne out in a series of trials which is being carried out on many sites in the Corporation by our factory agricultural development officers. The following figures indicate the average plant populations obtained:—

Drilling to Stand Trial—1970 and 1971
Plant populations—thousands/acre

1970	*Hand-worker*	*12·7-14·3 cm (5-5⅝ in)*	*15·2-16·5 cm (6-6½ in)*	*17·8-19·1 cm (7-7½ in)*	*20·3-21·3 cm (8-8⅜ in)*
Average	**30·600**	**32·800**	**28·800**	**25·400**	**23·000**
Maximum	35·100	41·500	37·700	32·800	27·800
Minimum	18·600	19·700	17·500	17·300	16·500
1971					
Average	**33·300**	**41·300**	**37·000**	**27·300**	**25·000**
Maximum	34·800	44·100	40·100	34·200	31·200
Minimum	25·700	26·400	23·300	18·500	17·200

Seedbed Preparation

In the light of my opening remarks it is obvious that, with the already considerable acreage which is drilled to stand and the likelihood of many more acres being drilled in this way in the future, great attention must be paid to detail when considering the preparation of seedbeds. There is an adage which I liked to use when taking about seedbed preparation, and that is: "do as much as you can in the Autumn and as little as you can get away with in the Spring". By this I mean that where there is a choice of doing any job either in the Autumn or in the Spring, then get it done as soon as possible before ploughing starts. I refer particularly to the application of lime and salt, both of which can be applied in the Autumn. (The lime application should preferably be applied in other parts of the rotation so that the land is at the correct pH, just prior to drilling the beet crop, but in many instances this does not occur in practice.) There is ample evidence to support the argument that a response to sodium remains constant whether it is applied in the Autumn or Spring, and although there are isolated cases of leaching where lime is concerned, in the main the same principle applies. Having done any of these necessary operations then ploughing should take place, preferably using a reversible plough, thereby eliminating any ridges or furrows. This operation should be done once only, in November or December, thereby giving adequate time for weathering to take place. In the Spring, as I have said, as few operations as possible must be used to achieve the final seedbed. Any seedbed preparation that does take place should be shallow, thereby keeping the frost mould on the surface and, in order that the best possible conditions are made available for the seed and the herbicide, the soil moisture must be retained.

Good seedbed preparation is achieved best by using a conventional Dutch harrow-type of implement, where there is a heavy frame containing straight tines which will work in the top 5·1 to 7·6 cm (2 to 3 in) of soil. This implement floats on the surface and the framework gives a scrubbing and levelling action as it is drawn forward. Normally this is complemented by the use of a scrubber board across the front of the implement, which does the initial levelling and breaking of clods. A single pass with this implement does not, however, give the final required results, and therefore some form of crumbler is needed for the final breaking down and consolidation. Crumbler barrels can be incorporated into the design of the Dutch harrow at the rear, or they can be as separate units which are trailed behind and used in tandem. In the majority of cases the former is used; the only disadvantage being that this type of crumbler barrel extends for the whole width of the implement and cannot follow the contours of the ground as well as the individual units.

Many methods have been, and are being used to prepare seedbeds, but with some combinations there is a danger of clods and unwanted soil being brought to the surface. Spring tine cultivators notorious in this respect, although it must be pointed out that sometimes a single pass of this implement is necessary to remove wheel marks created when spreading fertiliser, especially where cage wheels have not been used. Having mentioned cage wheels, it cannot be stressed too much that these are most esential in any operations concerning sugar beet seedbeds. Failure to use them can cause many problems and frequently where they have not been used the effects of wheel marks can be observed throughout the growing season.

As was said earlier, soil moisture is all important, especially for drilling to stand, and therefore any seedbed preparation should only be done just prior to drilling. With the use of crumblers for the final operation one is able to work the seedbed in the same direction as drilling, and thus enable the two operations to be done very close to each other.

Precision Drills

In 1971/72, of the Corporation's total acreage of 179,276 ha (443,000 acres), 97 per cent was drilled using two types of drill, and in fact these two have monopolised the British driling scene for several years past. There are two basic systems involved. The one operates by the use of a driven perforated rubber belt which rotates in a clockwise direction. The spacing is varied by the number of holes in the belt, and the hole size varies according to the grade of seed used. The action of the belt is very gentle and no damage to the seed results, and there is no build-up of seed dressing where this is involved. The other type of unit, on the other hand, drills by means of an aluminium alloy wheel with holes in its periphery which again rotates in a clockwise direction delivering the seed into the seedbed at the bottom of its travel. Again, the spacing and hole size varies according to seed spacing and grading. With this unit there is a slight danger of damaging pellet coatings if the material used is very soft, and also when using unpelleted seed with a seed dressing applied, a build-up can occur in the unit.

When operating any precision drill it is essential to ensure that the seed is deposited into soil moisture and, after extensive trials, we believe that, in the United Kingdom in a normal season, the depth of drilling should be 2 cm to 2·5 cm (¾ in to 1 in). Under dry conditions greater depths may be necessary, but anything deeper than 3·8 cm (1½ in) can reduce the number of plants emerging. In passing, it might be of interest to mention the experimental work which the British Sugar Corporation's Agricultural Development Department has carried out concerning seed coverers. Between the years 1964 and 1970, 34 sites were used to compare the emergence of sugar beet after drilling at four different depths, using six different coverer mechanisms behind the seed unit. The outcome of these trials is that, under normal soil conditions, the conventional British press-wheel has given the best results, the second best performance being obtained by using the continental concave roller.

Seed

As expressed in my opening remarks, the advancement in seed breeding has been very impressive during recent years. Consequently, if one compares the percentage usage of various types of seed during the past seven years, one can see how dramatically the situation has changed. In 1966 the figures were as follows:—

	Monogerm		*Polyploid*		*Diploid 8-10/64*		*Diploid 7-11/64*	
	Raw per cent	*Pelleted per cent*	*Raw per cent*	*Pelleted per cent*	*Raw per cent*	*Pelleted per cent*	*Raw per cent*	*Pelleted per cent*
1966/7	0·3	5·6	2·3	-	59·6	10·8	21·4	-
Now compare these figures with 1972/73								
	0·2	63·7	4·7	25·4	4·6	1·4	-	-

You will see there has been a tremendous increase in the use of pelleted monogerm and pelleted polyploid multigerm varieties, and a corresponding decrease in the use of the diploid multigerm varieties. This is due to the improvement in the quality of the monogerm varieties, particularly as far as weight and sugar are concerned, and in the fact that one of the polyploid varieties heads the commercial variety trial list for the best weight and sugar/ha (acre) of all those varieties now in use in the United Kingdom. I should point out that, during the last two years, there has been a slight decrease in the demand for monogerm varieties and an increase in the requests for polyploids; the reason being that the seed breeders will now guarantee at least 70 per cent monogermity in their polyploid varieties, and therefore growers are prepared to use them for 7·6 cm (3 in) spacing and drilling to stand, thereby getting the best of both worlds. This decrease in the use of the monogerm varieties may however, only be a temporary trend and, as the quality of these varieties improve, the demand will continue to rise. You will also see from the figures that a very large proportion of the seed is now pelleted. This greatly improves the drillability of both types of seed which, of course, is essential for drilling to stand techniques.

Herbicides

One of the outstanding problems with sugar beet growing, particularly where drilling to stand techniques are used, is weed control. Although great advancements have taken place in recent years to overcome this difficulty, the situation is still far from being completely solved. The use of herbicides in the United Kingdom is now quite extensive and approximately 90 per cent of the total crop receives some form of herbicides application. The table which follows indicates the present situation:

Pre-sowing	*Pre-emergence (residual)*	*Pre-emergence (contact)*	*Post-emergence*
15 per cent	80 per cent	0·3 per cent	9 per cent

You will appreciate that a proportion of the acreage will have more than one application of herbicide, and therefore the figures do not add up to exactly 100 per cent. The rapid increase in herbicide usage has been accentuated by the drilling to stand techniques which necessitate a clean crop for thinning, especially on those crops where electronic machines are used.

With post-emergence weed growth two major problems are appearing, one being couch grass and the other wild oats. Both these weed species are causing problems on many farms and much effort and research is going on to find suitable controls. After approximately 20 years of availability the chemical *TCA* has come into prominence for use as a control for couch. This chemical has been giving very useful control in the beet crop, either applied in the Autumn on the stubble, or about 14 days prior to drilling. Experimental evidence suggests that the Autumn aplication gives a good control if the chemical is applied early enough whilst the couch is still growing well, but as a twelve month treatment for sugar beet, the Spring application is quite suitable. Considerable experimental work is going on to try and discover any complementary action that might exist between *TCA* and any of the pre-emergence herbicides, but so far there is no concrete evidence to support this theory. During this experimentation careful studies are being made concerning the interval that is necessary between the application of this chemical to the seedbed and drilling the beet crop. At the present time a recommendation of one day per pound of chemical applied is regarded as being safe, although it would appear that perhaps this interval could be somewhat reduced. The main benefit of using this chemical for couch control in the beet crop is that it is not volatile, and therefore can be applied at a suitable time before drilling, but need not be incorporated until the actual seedbed preparation takes place. *EPTC* is extremely effective for couch control, but this chemical must be incorporated within 15-30 minutes after application and at least 14 days prior to drilling. This, of course, defeats the seedbed preparation objectives and therefore it is considered that this chemical is better applied to the potato crop in another part of the rotation.

The other major weed problem I mentioned is wild oats. This weed is particularly prevalent in the eastern part of Britain, and again experimentation is going on to try and overcome this situation. Di-allate is a chemical which is having great success in controlling this weed prior to drilling the crop. It is applied two to three days before drilling, and is incorporated within 30 minutes of application. This application, however, is close enough to the final seedbed operation not to interfere too much with soil moisture problems.

Considerable success is also achieved by the use of a tank mix of Pyrazone and Di-allate. This has proved to be very successful, particularly on organic soils where incorporation is again done two to three days prior to drilling the crop. As a post-emergence treatment to wild oats some interesting results have been obtained by the use of a tank mix of Carbyne and Betanal *E*. The most suitable dosage rate would appear to be four pints of Carbyne with seven pints of Betanal *E*. This mixture effectively kills off the wild oats in most cases, and also some of the grass weeds which are occasionally present. This mixture therefore is a useful stand-by if wild oats appear after the emergence of the beet crop. It should, however, be pointed out that the strength of Carbyne has been increased in 1972, and the name changed to Carbyne *B*.25. This rate, therefore, is no longer suitable, and our investigations are continuing with this new material.

As for pre-emergence herbicides, these can be grouped into two categories ie contact and residual. In actual fact, there is now only a very small acreage treated with pre-emergence contact herbicides; the total acreage being only 0·3 per cent of the total United Kingdom crop. On the other hand there is some 80 per cent of the crop which has an application of a residual pre-emergence herbicide. These residual chemicals can again be split into two groups, one group being more persistent but more expensive than the other. The expensive group contains Lenacil, Pyrazone and Endothal Propham, which appear to give a wider spectrum of weed control and longer persistence, and 66 per cent of the Corporation's acreage has one or other of these chemicals applied to it, and of that acreage 76 per cent is band sprayed.

In the other group we have Propham with Fenuron and Chlorpropham in various formulations, 14 per cent of the total crop being treated with one or other of these, and because this material is cheaper, 70 per cent is overall sprayed. Generally herbicides in this latter group are used with the intention of following up their application with a post emergence treatment of Phenmedipham. By doing so, the cost per ha (acre) is kept down to a reasonable level.

The post-emergence application of herbicides provides an interesting picture in that, although Phenmedipham is available, together with a residual post-emergence chemical Trifluralin, only a relatively low percentage of the Corporation's crop is so treated. One might imagine that much more acreage would be sprayed post emergence, but either hand labour is available to deal with a second growth of weeds, or the pre-emergence herbicide application persists long enough to give protection until the beet successfully covers the ground between the rows. Trifluralin is the only residual post-emergence herbicide available at the present time. Its cost is approximately £5·25/h 0·4 ha (acre) and, probably more important, this chemical must be applied in a weed-free situation when the beet are in the four to six true leaf stage. Incorporation must also take place within half an hour of application, and not only this be done, but the soil and chemical must be scattered around the beet plants within the row. However, where this chemical has been used there have been some very satisfactory results obtained. In a drilling to stand situation this residual benefit is very important, because generally in the United Kingdom there is a late or secondary growth of weeds of which chenopodium album (fat hen) is the most common.

Another approach to this secondary weed problem is being undertaken by the British Sugar Corporation Agricultural Development Department. A series of trials is being carried out whereby the weed is cut off at beet level at various intervals throughout the growing season. Although there is no conclusive evidence as yet, it is fair to say that where crops have been so treated the weeds appear to die off and cause no further problem in the beet crop. Certainly at harvest time there appears to be no difficulty with blockage in the harvester. As to whether the beet crop suffers a reduction in yield due to competition with this weed has not yet been established, but first indications are that, so long as the weed growth is not excesive, then no loss occurs.

Thinning

I do not intend to dwell too long on the various mechanical methods of reducing the plant stand, because in the United Kingdom at the present time there is only 0·9 per cent of the total crop on which selective thinning is used, and only 0·3 per cent which is mechanically thinned. The main opposition to selective thinners is the basic price of the machine, coupled with the rate of work.

Of all the types of mechanical aids available for reducing the plant stand the blind gapper offers a reasonably simple way of achieving the net result.

On a 7·6 cm (3 inch) spaced crop which has emerged reasonably well, this machine will leave a final plant stand which is acceptable in the majority of cases. It is an easy machine to operate and one which the farmer can really understand.

Summary

To summarise, therefore, one can say that the majority of beet growers in the United Kingdom are becoming more and more conscious of the need to minimise their production costs wherever possible. As manpower on the land decreases and wages increase it is esential to look towards the days when the entire crop can be grown without resorting to hand labour. In many aspects we are nearing this goal, although there are still many obstacles to be overcome. Growers are beginning to specialise even more in the growing of their crop and every effort is being made to obtain first-class seedbeds from which a high emergence can result. There are mechanical aids available for reducing plant stands but at the present time these are not being widely used.

In the western part of the country circumstances have forced the issue and growers are learning to achieve a completely mechanised crop by drilling to stand techniques and, as the quality of the monogerm seed varieties improves, and as the herbicides become more and more reliable, this trend will rapidly spread to the remainder of the United Kingdom sugar beet growers.

SUGAR BEET AND POTATO PRODUCTION IN EUROPE

Edited Summaries of Discussions – Day 1

Discussion Papers 1, 2 and 3

Mr F. Coolman President, Section III, *CIGR*) asked what factors affected the quality of the juice extracted from the beet in the factories and if there was any association between juice quality and mechanisation.

Mr M. Martens in reply drew Mr Coolman's attention to his illustration comparing hand picked and mechanically harvested beet. Quality is lower in the case of mechanically harvested beet at any corresponding date of harvesting but an agronomic problem is thought to be more important today and is now the subject of research. The hypothesis is that the current high level of use of herbicides and insecticides may be having an effect on the level of microbiological activity in the soil which in turn slows the assimilation of nitrogen and this delays maturity.

Mr Boiteau (Technical Institute of Sugar Beet, Paris) asked if the growing scale and sophistication of mechanisation could cause a relocation of the beet growing industry to easily worked soils in areas of large farms.

Mr M. Martens thought that relocation was not likely to occur but that rationalisation would take place where the average area of beet per farmer was low. Countries such as the Netherlands and Belgium where the average is about three hectares (7·5 acres) per farmer.

Mr C. Culpin asked Mr Jorritsma to comment on the rapid change to pelleted monogerm seed in *UK*.

Mr J. Jorritsma stated on the continent the range of use of this type of seed was from 2 per cent in Netherlands to 80 per cent in Denmark. In *UK* he assumed that uniformity of the seed was very important so that modification or adaptation of seeders was unnecessary, a useful feature for contractors. The yield from pelleted seed may be less than non-pelleted in some conditions and in some countries there is an increasing interest in the non-pelleted seed.

Mr A. C. Owers asked for more information on Mr Martens' indication that some increase in yields were due to timeliness of cultural operation as distinct from improved varieties and manurial practices.

Mr M. Martens in reply said that the earlier yield figures were prior to wide-spread mechanisation and he did not believe mechanisation depressed yield. The increases in yield were common to all countries.

Mr Boiteau said that in France yields had increased 50 per cent between 1960 and 1970. Varieties were responsible for 15 per cent of this, dates of drilling 25 per cent harvesting date 10 per cent and the remainder to increased plant population.

Mr M. Martens asked the reason for increased use of polyploid in *UK* now.

Mr D. R. Brisbourne thought that the reason is that seed breeders guarantee more than 70 per cent monogermity which makes them suitable for drilling at 75 cm (30 in.) spacing. Now that this seed is pelleted it does tend to drill better than previously. Also a polyploid variety is at the head of the list for yield and sugar content.

Mr F. Coolman wished to know more about the protective coatings applied to the seedbed described by Mr Martens.

Mr M. Martens said these products were by-products of the plastics industry and were purely experimental. In two years experiments they have shown improved soil structure but no difference in field germination has been noted because both treated and non treated have had good germination. It is thought the products may be very cheap.

Trends In Sugar Beet Harvester Design And Systems Of Handling*

by W. Brinkmann†

THE generally known rising demand for higher incomes of those employed in the field of agriculture, will only be satisfied to some extent by higher production and an increase in prices. To minimise the need for workers, developments in the field of sugar beet harvesting tend to rely more and more on mechanical energy.

If you follow the progress, starting with year 1963, the increase in mechanisation of the sugar beet harvest in some European countries—demonstrated by the proportion of the crop mechanically harvested—one can see even then a relatively high standard of mechanisation. At present we see that in most European countries the sugar beet harvest is practically completely mechanised.

From the varying technical needs of different countries for a sugar beet harvesting process three basic processes have emerged, out of which 20 different mechanised systems have been developed up to the present time. The three basic processes in the harvesting of sugar beet, are topping, lifting, and transportation of the harvest out of the field, using one, two, or three separate machines. Therefore, they are called one phase, two phase, or three phase sugar beet harvesting processes.

The statistics show also, that from 1963 onwards in some countries only one or two of these basic processes have been adopted. It is interesting to see that in these countries, where earlier only one of these basic processes was mechanised, in recent years three phase processes have been preferred. Countries previously using mainly three phase processes have a definitely tendency today towards one and two phase processes.

These tendencies are not contradictory as the one phase one row working system and the three phase system, working simultaneously on six rows of sugar beet show the same amount of time needed per person to work one hectare of ground for the process of lifting. The one phase one row working process can be achieved during harvesting by one man, whilst the three phase six row system needs five workers to service it. Therefore the average attainable output must be five times greater and show a smaller capital outlay for the three phase six row system.

One is therefore prepared to depart from the one phase system and the possibility of the one man work, asking higher output from the work organisation for a smaller capital outlay and at the same time accepting a shorter harvest season.

With farmers who have used the one phase system there is a further tendency to change from the present one row machines to multiple row machines but still using one man. The more rows these machines can work the greater the output and work productivity.

One of the conditions for the development is the availability of bigger power units but there are limitations. A two row one phase machine needs at least 80 hp. With these machines, the traction unit must propel the unit as well as driving the topping and clearing mechanisms. The loss of harvest due to running over the rows can be avoided. With further increases in the number of rows to be worked by the machine, the necessary increase in the output of the tractor means more wheel slip for the tractor which warrants greater width of tyres and presents new problems.

With the greater number of rows two, three and six row units one phase machines are made as self propelled units with engine capacity between 90 and 193 hp. Understandably, with one phase multiple row bunker machines of this kind there is a considerable increase not only in the weight of the machine, but also the weight of the contents of the bunker. Temporary storage of the sugar beet lessens the work productivity. There is still insufficient evidence to show which number of rows and total weight will be manageable in difficult weather conditions on a sloping land. Maybe a compromise can be achieved by harvesting less than six rows.

Another possibility to reduce bunker weights may be simultaneous loading of the sugar beet via a small bunker to a vehicle driven alongside, for which one has to consider a one phase process with two or three further transport units.

Contrary to this, one endeavours to depart from the three phase process by combining the number of work phases and at the same time minimising the number of workers with possibly equal output but naturally a higher capital outlay.

→ *foot page 26*

** Presented at the Commission Internationale du Genie Rural and the Institution of Agricultural Engineers Joint Autumn National Meeting at the National College of Agricultural Engineering, Silsoe, Bedfordshire, on 2 October 1972.*

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Performance Assessment of Sugar Beet Machinery*

by G. L. Maughan FIAgrE†

Summary

PERFORMANCE assessments were first introduced at the National Sugar Beet Harvesting demonstration held in 1950. Since that time techniques have been developed for both precision drills and the more sophisticated sugar beet harvesters now in use. The paper examines the problems of making performance assessments, and describes some of the administrative problems that have to be overcome. It is realised that the data obtained during such assessments, that coincide with national demonstrations attended by the general public, seldom reveal differences that are statistically significant. Nevertheless it is felt that these data have come to be accepted and appreciated by both the manufacturers who participate, and the visitors to such events.

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† Agricultural Development Department, British Sugar Corporation Ltd.

concluded from page 25

Self propelled machines have been developed for the work phase topping and lifting. By a further separate process the sugar beet is transferred to a vehicle driven alongside, or they are being topped on one machine and then the lifting as well as the loading on to a vehicle alongside is being carried out by a further self propelled machine. Here in comparison to the original process the number of simultaneously working units has been cut from five to three or four.

The potential output of the new multiple row prototypes used in the various systems is growing faster than the size of sugar beet area of the majority of farms. The costs and increase in the capacity of the large self propelled sugar beet harvesting machines force one to use the complete production potential. This again is only possible by rationalisation of the working conditions and organisation, taking particularly into account all possibilities of sharing machines and co-operation in future development.

In the light of these developments, the human inputs change through further easing of manual work; by the use of automated processes within the machines, as the physical burden is eased, the psychological burden will increase, and for this reason a higher degree of interest will have to be shown in the working environment.

Introduction

Performance data are collected to allow comparisons between machines, and thereby assist a decision. In the case of a farmer or user it may be the choice between a particular machine and its competitors, whereas a development engineer will be seeking guidance as to how a detail of design will influence the behaviour of a particular machine, while an adviser may be looking for a machine to play a part within a system in which certain limitations are already laid down. The type of information required and the manner of its collection will be different for each requirement, for whereas the user will want the opportunity of seeing all available machines at work side by side under practical conditions which, preferably, will be closely akin to those on his farm; the engineer will try to maintain identical conditions for each of his alternative designs even if such conditions are somewhat removed from those found in practice.

Comparative endurance testing, in which machines are worked until in danger of wearing out, although of particular interest to the farmer, is seldom practical, for field conditions, types of soil, presence of stones etc vary so much that the results can seldom be translated into terms that will indicate the life expectation on any one farm. More meaningful information on this aspect of machine performance is likely to be obtained from user surveys, even if the details of the manner, extent and conditions of use are less precise.

The effect that the introduction of a particular type of machine may have on the system of harvesting or the system of sowing, is an aspect which must also be considered. So many operations in the growing of sugar beet are related to each other that the implications of changing any one machine must be considered carefully before the final choice is made. Thus, the purchase of a multi-row harvester may involve changing the number of rows in the drill, the tractor hoe etc and possibly even the row width. Similarly, multi-row harvesters may demand different transport arrangements and increased root storage capacity if the full potential of their high capacity is to be utilised.

Drills

Drills are required to isolate or meter individual seeds and after positioning them, cover them with soil so that the seedlings emerge in a pattern that is compatible with subsequent cultivation and growth of the crop. Seedling emergence and distribution is influenced by the characteristics of the drill mechanism, the suitability of the seedbed to provide the correct environment for maximum emergence, the skill of the drillman to set the machine to match the seedbed, the germination capability of the seed, and the climatic conditions subsequent to drilling. Obviously the last of these factors is outside anyone's control, but providing the seedbed is in reasonable condition, it is unlikely that in the majority of soils, a particular form of weather will favour one particular drill. It is necessary to qualify this statement, because, on soils which have the tendency to form a crust, certain forms of coverer may create a cap or crust which subsequent rain can make impossible for the seedling to penetrate.

Numerous attempts, so far without success, have been made to develop a technique which can be used in the laboratory for predicting the field emergence of seed. There is no reason to suppose, providing the seed is not damaged by the drill, that the capacity to emerge in the field is influenced by the machanism of the drill, nevertheless comparative field performance assessments of different types of drill should be made with the same batch of seed.

Similarly, a drill must be capable of working satisfactorily on the very wide variations in soil types and conditions under which sugar beet is sown. It is almost impossible to prescribe the seedbed conditions that would favour one design of drill rather than another, unless such obvious factors as crop residues, excessive stones etc are considered.

The assessment of drill performance, therefore, calls for a study of:—

1) the ability to segregate or isolate individual seeds or pellets from the reservoir incorporated in the drill;
2) the suitability of the soil-working parts ie furrow openers or coulters, and the coverers.

It is, however, unwise to study one of the aspects without due consideration of the other. There is, for instance, very little to be gained from developing a metering mechanism with a high degree of accuracy and repeatability of seed spacing, if the passage of the seed to the soil, or the soil working parts themselves, upsets the precise seed spacing, or if it cannot function at a reasonable speed. It is sometimes argued that only perfection of spacing is acceptable, without any attempt being made either to define or justify what is meant by perfection. In practice, so many agronomic factors contribute to displacing the seedling as opposed to the seed, that it is probably of little practical importance where the seedling emerges providing it is within 20 per cent of the nominal spacing.

In practice it is necessary to ascertain:—

1) how many seeds have been planted, and how many seedlings have emerged in length of row;
2) the uniformity of spacing between the seedlings.

The number of seeds sown is usually determined by either counting or weighing the quantity of seeds sown in a known length of row. The minor errors introduced by variations in the seed count ie the number of seeds/kilogramme (per pound) can be eliminated by extending the length of the sample row.

The ability to achieve a particular spacing between seeds is probably of no great practical significance to an individual farmer, providing the increments on either side of his desired or target spacing are not too great, ie no one will worry if, due to its mechanical construction, a drill can only achieve 10·8 cm (4¼ in) spacing, when 10·2 cm (4 in) spacing is required.

Differences in seed spacing achieve a greater significance when making comparisons of the number of seedlings per unit length and their singleness. The latter is, in part, a function of the monogermity of the seed.

The collection of data necessary to prepare the histograms used to show the pattern of spacing is time-consuming and tedious but has been greatly facilitated by the technique developed by the National Institute of Agricultural Engineering. In this, a strip of paper carried in a special frame is laid alongside the row of seedlings, and perforated to indicate both the position and number of seedlings at each station. The paper strip is later coded and fed through an electronic reader which prepares a punched tape for analysis by a computer programmed to produce the information in the form of total seedling-in, percentage singles and total seedlings. The computer also calculates the number and percentage of seedling spaces from 0-61 cm 24 in (0-) by size intervals of 1 cm (0.4 in). As an additional service the computer print-out shows, within the limits imposed by the printer, a mock-up of the plant distribution histogram.

In order to achieve reasonable accuracy it is necessary to take a number of counts, although in practice these are usually limited by the availability of man-power. In the field each 254 cm (100 in) count takes about a minute, depending on how many can be put on to each roll of paper strip. The coding, examining and correcting of each count takes a similar time.

It is often suggested that the histogram is an inconvenient method of showing plant distribution, and that a single factor would be very much more satisfactory, but hitherto such factors have only provided very limited comparisons.

Apart from the distribution pattern, the most important information is the relative plant establishment, or seedling emergence. It is usually expressed as seedlings per 100 seeds sown. This, in effect, reflects the efficiency of the soil working parts of the drill, and the skill with which they were set in relation to the prevailing conditions.

It is interesting to note that the results of the drill assessments published at the 23rd National Sugar Beet Spring demonstration at Cantley in May 1972, showed less than 5 per cent doubles (ie spaced within 1 cm). The pelleted monogerm seed used for the trial had a laboratory monogermity of 96 per cent. At this same event about 60 per cent of the seedling spacings lay within ± 20 per cent of the target when the drills travelled at 4 km/h (3 miles/h), but increasing the forward speed to 6·4 km/ h (4 miles/h) reduced this by about 6 per cent in 1972 and 11 per cent in 1971. As both drills and operators were the same in the two years, it is possible that the difference can be attributed to the interaction between seedbed and speed. In practice, the majority of farmers operate their own drills at between 4-4·8 km/h (2½-3 miles/h), thus endorsing the significance of the results shown in the table.

The table compares the results obtained in 1971 and 1972 from three models of drill.

	Speed		*Target*	*Seedlings*
	(miles/h)	*(km/h)*	*± 20 per cent*	*per 100 seeds*
1971	3·2	(2)	61·2	61·2
	4·8	(3)	57·0	62·1
	6·4	(4)	45·2	53·2
1972	4·8	(3)	62·3	75·2
	6·4	(4)	56·1	77·2

Harvesters

The harvesting operation involves a number of tasks which are carried out more or less simultaneously, and which are so inter-dependant that it is necessary to study every one. The most obvious interaction is that of speed and quality of work, and the attempt to assess one without the other immediately produces the natural reaction on the part of the operator. Thus, although it is convenient to discuss each parameter separately it is essential that due regard be given to its place in the whole operation of harvesting.

Topping—most contracts require the beet to be topped with a horizontal cut below the lowest leaf scar, because above this level, changes within the root cause what sugar is available to be of poorer quality and more difficult to extract, and also because the impurities present are liable to contaminate the better quality material found in the root itself. Assessing the standard of topping therefore involves an examination of the extent to which the line of topping has deviated from the 'contract line'. Obviously this deviation can be either above (undertopping) or below (over-topping) the 'contract line'. The cut is sometimes not horizontal, and may either enter or leave the root above the 'contract line' leaving some petiole material on the root. Such green material is particularly abhorrent to the processor, for as little as 10 gm (0·35 oz) can produce as much impurity as is found in a normal 700 gm (1·54 lb) root that has been properly topped.

Some growers require their tops for feeding to livestock, and are therefore probably prepared to set their topper units to cut the beet lower (ie overtop) than those whose whose sole concern is to deliver the maximum weight of crop. Certain harvesters incorporate special top-saving equipment so that the tops can conveniently be collected for carting away, although this tends to complicate the harvesting operation.

Lifting—an efficient lifter not only digs all roots irrespective of size, but does so with little or no breakage and the minimum of soil. In practice the setting of the lifter unit is a compromise between maximum depth and minimum soil, and varies according to the size and shape of the roots and the type of soil. An assessment of lifting therefore requires sample lengths of row to be examined for subterranean losses as well as samples of lifted roots for unwanted soil.

Loading—this operation usually incorporates a certain amount of cleaning or soil removal, and as such, sometimes results in roots being allowed to fall to the ground and so lost.

Output—the rate of working which can be expressed in terms of ha (acres) h or ha (acres)/h man-hour, demands a close study of exactly what is being achieved, and an identification of the limiting factor. Until the advent of multi-stage harvesters it was a comparatively simple problem to record the area of ground covered in unit time, and ignoring, for the sake of convenience, any hold-ups caused by the absence of carting vehicles, calculate a net rate of work or an overall rate of work if delays caused by break-downs were included. Such a system of recording does not provide any information as to the effect that the haulage problem or haulage capacity may have on the rate of harvesting. There are so many variations of vehicle size, haulage distance and turn-round time which may inter-act with row length and crop yield, that such studies are more appropriate to field surveys.

The introduction of tanker harvesters partially simplified the haulage problem, although probably now calls for an even finer degree of balance between carting unit capacity and haulage distance.

Multi-stage harvesters are usually operated to the capacity of the slowest unit, so that although the net rate of individual units is considerably higher, they may have to stand idle while waiting for the slowest unit to catch up. If the loading and carting unit is the slowest there is no reason why the topper and lifter should not stop work earlier in the day, so allowing the drivers to be available for other work while the crop is loaded and carted. On the other hand, if the pace is set by the topper or lifter, there is no opportunity of releasing the men, and the overall rate of work must include the time so lost.

National Demonstrations—in 1950, the recording of quality of work and output was introduced for the first time at an international working demonstration. Fourteen machines took part. Since that time the principle has been applied to other crops and types of machinery and is now accepted by both the participants and the visitors as a very necessary stimulus to events of this sort. In the course of time both the scope and depth of the recording has increased, so that the organising of such an event involves detailed advance planning.

At a recent demonstration held in Great Britain, arrangements were made to assess the performance of 11 single-stage harvesters and five multi-stage harvesters. It was considered necessary to obtain three complete sets of samples from each machine in each working session (2¾ hours); at the same time detailed records were made of the amount of work done, and the reason for any hold-ups. The task of harvesting the beet was considered to be finished when the roots were loaded into the carting vehicle.

Each set of samples comprised:

3) under-topping and dirt tare—twin samples of roots each approx (30 lb) 13·5 kg;
b) over-topping—tops collected from 30 m (100 ft) of row;
c) surface losses—roots collected from 30 m (100 ft) of row;
d) dug losses—roots dug from 30 m (100 ft) of row.

In the case of multi-row machines, samples (b) (c) and (d) were gathered from the full width of the machine. The twin root samples (a) were taken from the designated trailer as it passed through the central sampling point, whereas the samples of tops (b) and losses (c) and (d) were gathered by six mobile teams that travelled from plot to plot behind the harvesters.

Obviously such an organisation poses complex staffing problems which can be judged from the fact that, in the field there were about 22 supervisory staff, and nearly 50 tractor drivers or farm workers collecting the samples, plus a tare-house team of 12, and a further two stewards to each machine recording output.

In the course of this demonstration 384 samples of roots were examined, and 12·8 km (42,000 ft) of row, equivalent to 0·56 ha (1·4 acres) were examined and gleaned for samples of tops, and a similar area for surface losses and dug losses.

Conclusion

In spite of the fact that they will seldom show differences that are statistically significant, the collection and publication of performance data is now expected and followed with close interest by both manufacturers who enter machines, and members of the farming community who attend national sugar beet demonstrations. The number of machines means that a considerable amount of work is involved in the collection of these data, both before, during, and after the events. The principal value in performance data so collected lies in the fact that many machines work side by side under more or less similar conditions, and various aspects of their performance can be compared.

Sometimes the data are criticised for being too elaborate, and the critics have attempted to produce a single scale or ranking in which the machines appear in order of merit. The value of such rankings is doubted because there are so many different criteria which can be applied eg the stock farmer is much more interested in the condition of the tops than the arable farmer, while the light land farmer does not need such severe cleaning mechanisms as the man who is growing sugar beet on the heavier soils.

SUGAR BEET AND POTATO PRODUCTION IN EUROPE

Edited Summaries of Discussions – Day 1

Discussion Papers 4 and 5

Dr P. C. J. Payne asked if the British Sugar Corporation had ever had the opportunity of correlating machine sales with harvester trial results.

Mr G. Maughan replied that there was no information on this but he was gratified by the publicity the trials attracted and the amount of use made of the date in advertising material.

Captain E. N. Griffiths (Howard Rotavator) was concerned with the inaccuracy of toppers working in very leafy conditions and asked if a flail device could be incorporated in the topping mechanism to remove the leaf before the removal of the crown. If this reduced overtopping it would be very useful.

Mr W. Brinkmann said that this system was already used but that setting was critical and accuracy was only achieved at low speeds. Topping problems increase when the crop spacing is less uniform as is the tendency with reduced labour used for singling. There is a challenge to produce mechanisms to cope with this situation.

Mr R. A. den Englese (Farm manager, Norfolk) asked if the collection of tops necessarily showed the harvesting of beet and how could this be assessed.

Mr W. Brinkmann said that tops were very important in some countries, in Denmark and the German Federal Republic 80 per cent of tops are used for cattle fodder. For feeding the leaf should be attached to the crown and topping tends to be lower. Higher topping is practised where the tops have no value to the grower, this maximises the weight of beet but can lead to quality problems at the factory and a lot depends on what the factory inspectors will tolerate. The collection of leaf from field rows by front end loader requires 25 man hours/ha ten (man hours/acre). This can be reduced to eight man hours/ha (3·2 man hours/acre) if the leaf is directly loaded into hoppers and dumped at the edge of the field.

Mr F. Coolman thought that a tractor driver with a front end loader could load one hectare (2·5 acres) of tops into a trailer in three hours.

Mr M. Martens said that a number of self propelled harvesters had recently appeared with top saving devices. The top savers appear to slow the harvesting operation by 15 to 20 per cent.

The quality of tops saved by simultaneous collection is greatly improved since picking up with a front end loader introduces much soil into the silo.

Captain E. N. Griffiths asked if silage made from tops was stored in tower silos or was the moisture content too high. He also quoted work at the University of Iowa where 20 per cent straw was added to absorb the liquor.

Mr M. Martens said in his area only trench silos were used.

Mr F. Coolman said in Denmark wooden tower silos were used but that there was considerable loss of liquor which also smelt.

Mr J. M. Beeny *(NCAE)* asked if it was not better to increase the number of rows harvested simultaneously than to try to further increase the forward speed of harvesters.

Mr G. C. Mouat (Writtle Agric. Coll.) said that six and eight row machines were being used but the problem of transport over public roads was so difficult that their use was rather unsatisfactory.

A Survey Of European Production Of Potatoes*

by J. M. Glotzbach†

I SHALL restrict the survey to the countries of the present six *EEC* countries and those that will be added to make them nine. Nevertheless, the diagrams will show Norway since they were prepared before the referendum was held.

The potato crop is relatively more important in some of the countries than others as is shown in Fig 1, where a full circle represents the area and the segments illustrate the ratio between cereals, beet and potatoes. The Netherlands stand out in having nearly 25 per cent of the arable land under potatoes; more than twice the figure for any other country. However, these diagrams should be studied with reference to the national production figures shown in Fig 2, for 1960 and 1971. Here W. Germany is the top producer with over a 1,000,000 hectares (2,471,050 acres) in 1960 and the Netherlands fall to fifth place.

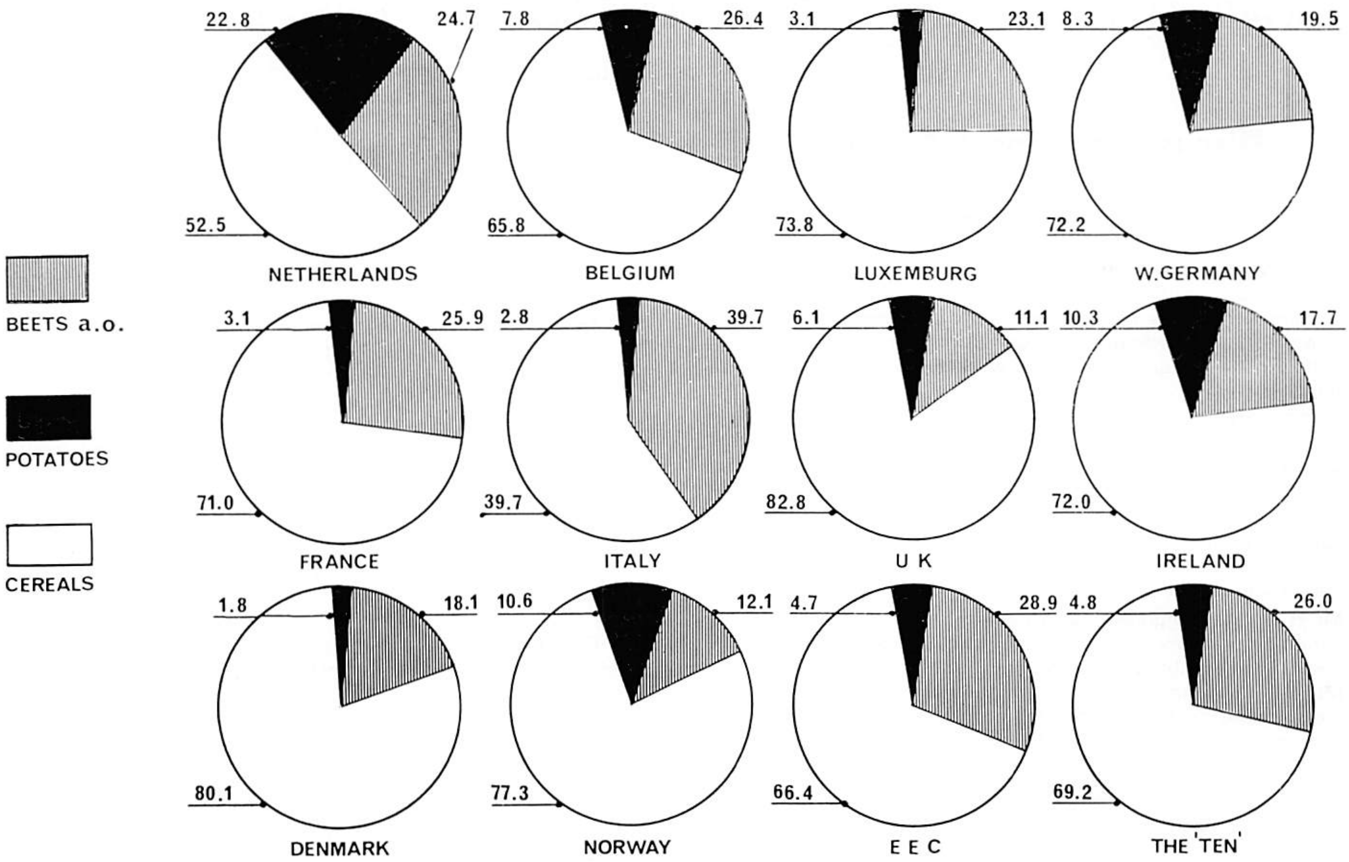
The general trend has been for the area of potatoes to fall. This fall has been dramatic in the case of Germany and France. The reasons for this are:

1) Changes in the methods of feeding pigs, which used to be fed on potatoes and are now fed on cereal based concentrates.
2) Low prices which were caused by the rapid move away from potatoes for pig feeding which was not matched by a corresponding decrease in the potato area grown.
3) Potatoes are now being imported from other *EEC* countries which were not traditional suppliers. This has particularly affected Germany which is the largest importer in the *EEC*. France is the only country which

* *Presented at the Commission Internationale du Genie Rural and the Institution of Agricultural Engineers Joint Autumn National Meeting at the National College of Agricultural Engineering, Silsoe, Bedfordshire, on 3 October 1972.*
† *Commodity Board for Potatoes, Netherlands.*

Fig. 1

ARABLE LAND 1970



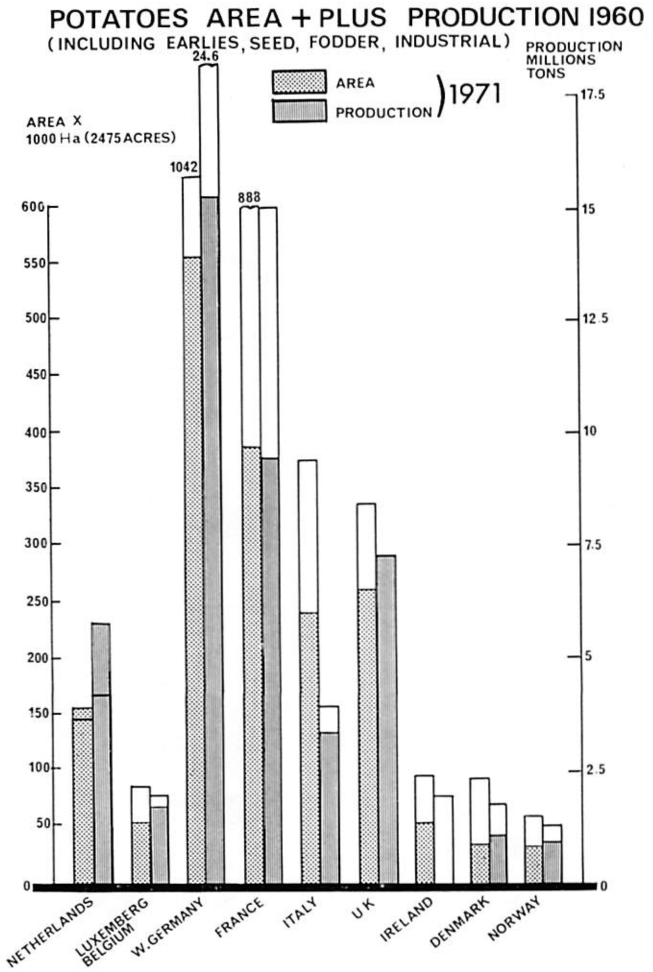
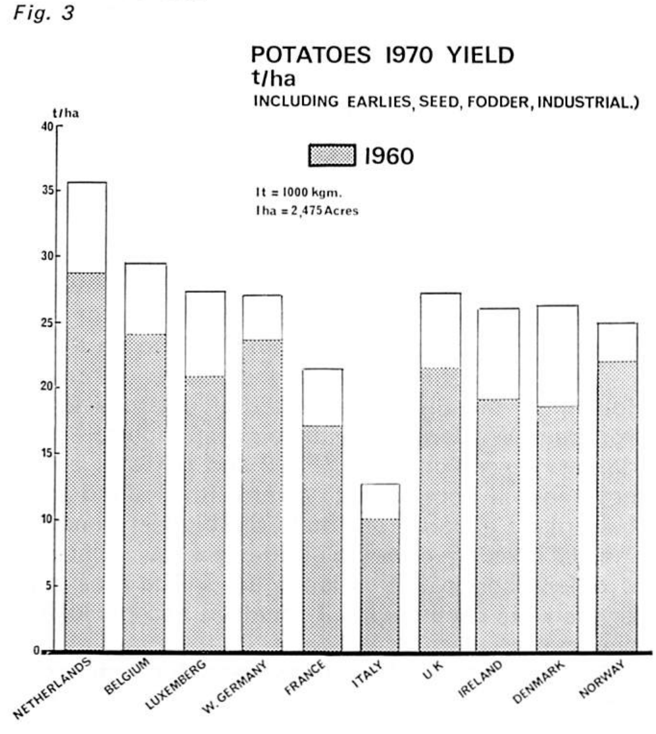


Fig. 2

has not been affected since although in theory her frontiers are open, in practice they are not, because a minimum price system is in operation which taxes imports to bring the price to her own market levels.

Fig. 3



4) The yield of potatoes has risen and less area is needed to give the necessary production. Fig 3 shows the differences for each country between 1960 and 1970.

The factors which have brought about the increased yield are:

1) The changes in the cultivation of the crop particularly in the control of weeds and potato blight by chemicals leading to a longer growing season.
2) The use of improved varieties.
3) The use of high quality healthy seed.
4) As the area grown has decreased the crop is grown on the better soils the poorer soil types being given over to other crops.

The human consumption of potatoes varies considerably within the ten countries (Fig 4). Ireland is

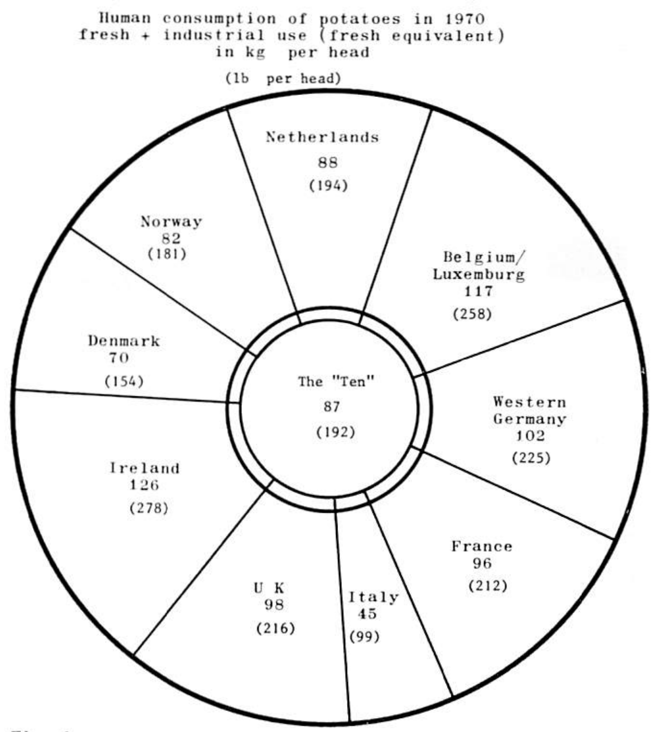


Fig. 4

at one extreme at 126 kg (277 lb) /head/annum, and Italy at the other at 45 kg (92 lb) /head/annum, which is to be expected since a large part of the diet is of cereal origin in the form of pasta.

Consumption per head has decreased significantly since the high level of the war years owing to rising standards of living and also the influence of the doctors in advising that potatoes are fattening.

The decrease in fresh potato consumption has been partly compensated by the use of processed potatoes in the form of crisps and chips, but this compensation is not as great in Europe as it has been in *USA* where ccmpensation has reached 50 per cent compared with Europe of 15 per cent which means there must still be plenty of scope for the processors. Fig 5 shows how potatoes are used in the *EEC* countries. The complete circle represents total production and as can be seen, there is a considerable variation in use.

The Netherlands show a considerable export amounting to 21 per cent also there is a starch industry which consumes more than 2m t of potatoes.

Aspects Of Soil Preparation And Planting For The Potato Crop*

by G. J. Poesse, U. D. Perdok, E. Strooker†

Soil Preparation

SOIL preparations for the potato crop are necessary to provide favourable conditions, first for plant growing and second for mechanical harvesting operation should be no more than lifting and transporting the potatoes to bag, container or trailer without any hand labour. For this reason potatoes are planted in ridges, built up from fairly crumbled, but not too fine, loose moist soil and with a base of about 50 cm (19·68 in) a height of about 25 cm (9·84 in) and rounded side walls (cross-section +650 cm^2) (100·77 in^2). With an average row distance of 75 cm (29·52 in) this means a layer of about 10 cm (3·93 in) loose soil, that must be prepared to build up the ridge. The planting depth depends on soil type (moisture supply, temperature) and ranges for the topside of the tuber from 0 cm to 5 cm (0 in to 1·96 in) below the surface. On clay, soils ± 5 cm (1·96 in) loose soil will be necessary below the tubers to prevent clods by harvesting. Because of the annual increase in tractor dimensions (tyre width and tractor weight) research is being done on row distances of 90 and 105 cm (35·43 and 41·33 in). The first one shows possibilities of success but brings more problems in soil preparation.

There are several ways to prepare a layer of 10 cm (3·93 in) loose soil, dependent on soil type and conditions. Normally, soils are deep cultivated in the Autumn or beginning Winter, preferably under dry conditions, to a depth of 20 to 25 cm (7·84 in to 10 in) with plough or spading machine.

The spading machine is sometimes used on the heavier soils. The advantages are no wheel spin (pto driven implement) no wheel in the furrow, loosening of the subsoil (compact layer below the normal working depth) and a somewhat rough surface. The disadvantage is the poor burying of vegetable materials (weeds, green crop).

When there are periods of light frost during the Winter, a Winter cultivation is done on the heavier soils. The soil must be frozen so deep, that the tractor wheels drive over it and the tillage tool, a rigid tined cultivator, penetrate through it. The soil is then already levelled and less work on soil preparation has to be done in Spring time.

Seedbed preparation in Spring time must be done with machinery provided with tines as working tools under dry soil conditions. The depth of working (in how many operations a good ridge is formed) and the choice of the machinery (pulled or pto driven) is determined by soil type and soil conditions.

Under normal Dutch weather conditions, with much rain during the Winter, soils are wet in the early Spring. The heavier the soil, the more time it takes before it will be dry enough to work on a depth of 7-10 cm (2·76-3·94 in).

To prevent late planting, soil preparation in two or three phases would be preferable then. In this case, the first one will be done over the full width, the second and third will be executed inter-row.

Also in that case the ridge must be built up in a short period to preserve moisture and to prevent damage to the roots. Tines as working tools are necessary, because of the small cutting part in proportion to the working width. Soil cutting under somewhat wet conditions can cause soil smearing with all its problems. Besides the work of a tine in the soil is controlled by the pressure pattern. By this a crumbling along the natural structure pattern comes into existence, by which the intensity of tines is defining the fineness of the tilth. The seedbed must be not too fine, not too dusty, but contain aggregates. Otherwise the ridge will be easily compacted during rainfall and will get a high water content, that can result in too low on air content for plant growth.

As a result of all these factors farmers on sandy soils and light loam soils use harrows or spring tine cultivators for seedbed preparation. On these soil types it is always possible to work deep enough to drain the required amount of loose soil.

After planting the ridges are built up in one operation with ridgers on a toolbar. Under somewhat heavier conditions the soil is usually still dry enough to prepare the whole seedbed in one operation, but it is not possible to do it with towed equipment. Here the powered harrow is well adapted; these machines are fitted out with plates, or with a rotary tiller for a good depth control and levelling of the surface. The wheels of the tractor with planter may

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† Institute of Agricultural Engineering and Rationalisation, Wageningen, the Netherlands.

compact a part of these loose soils. To prevent this, ridgers are fitted in front of the tractor wheels.

A combination of seedbed preparation and planting in one operation reduces soil losses by compaction.

On heavy loam and clay soil on which more operations are necessary, the first one is mostly done by normal harrows. The purpose is to level the soil layer that has been crumbled during the winter period.

Because this is a not very intensive operation, some farmers omit it and plant the potatoes directly with ridgers in front of the tractor wheels. Mostly there is enough loose soil to build up small ridges, Fig 1.

Fig. 1 Ridgers fitted in front of the wheels.

The following soil tillage operations are inter-row with small inter-row harrows or with inter-row rotary cultivators. There are two types of this last machine one with a horizontal axle, turning in a vertical plane, and one with vertical axles, turning in a horizontal plane.

Planting

For a good potato crop as well as to facilitate mechanical operations in the field, planting has to meet the following conditions: straight rows, equal planting depth, equal distance between the rows and accurate spacing of the tubers in the row. Specially for the seed potato production the tubers must be pre-sprouted (sprouts from 0·5-3cm [0·20-1·18 in]) for a more rapid and even emergence, necessary for the shorter growing period and an easier field selection. During the planting process the tubers and the sprouts must not be damaged and the whole operation must go on at a good speed.

For all these reasons the problem for seed potato-production is the sprout damage, while transport and hopper filling are the limiting factors for the other potato crops. For these the new automatic planters, sometimes with one big hopper for four rows, sometimes with two vertical chains with cups for every row and a solution. In the Netherlands, systems of bulk handling of seed potatoes are coming up and in this way farmers try to obtain higher capacities.

Finding a solution for the sprout damage problem is more difficult. Till now most of the sprouted potatoes are planted with tool bar mounted hand feed planters or with semi-automatic planters. The first one has the advantage that no sprouts are damaged, because these do not make contact with machine parts. The troubles with this machine type are the very tiring—sitting position of the operators and the very low output (max. speed 1·8 km/h) (1·12 miles/h). The semi-automatic machines have a higher rate of work than the hand-feed planters, because of the better working position of the operators. and the damage to the sprouts is very low. However, every planting element needs an operator, so a four row machine needs four operators and a tractor driver, and that is too many people for the low rate of work. The automatic planters damage the sprouts and an uneven emergence or gaps are the result. Well hardened sprouts or seeds with just "open eyes" may limit this damage, but this way of preparing sprouts wil be based on a special planting day. Rain can interfare with the programme and the results will be longer and softer sprouts.

No sprouting gives lower yields on the early seed-potato harvesting dates.

Some acceptable solutions for planting-sprouted potatoes with automatic planters have been found, but they are still labour consuming and give low rates of work. One method is an automatic planter with a special hopper shape in which the chitting-trays with the sprouted potatoes can be dumped very easily. Only a thin layer of potatoes may be put on the bottom of the hopper and the speed of the planting chain (forward speed) must be very low. During the work one man for two rows is necessary to refill the hopper. Another possibility is a hopper with a moving bottom. Also here a special man for filling is required. Another automatic planter has a mechanism specially designed to handle sprouted potatoes. An oscillating plate delivers the tubers in groups out of the hopper into a pair of belts arranged in a vee. The belts convey the potatoes backwards and drop these into the furrow. The system is in contrast to the automatic planters, not forced feeding. For this reason this type of planter has a very irregular spacing in the row, while an even distribution is necessary for a good field selection.

The Institute of Agricultural Engineering and Rationalisation in Wageningen, together with some factories is working on this problem, of finding better planting systems for pre-sprouted potatoes, Fig 2, 3, 4, 5.

→ page 36

Fig. 2. Automatic planter with big hopper.

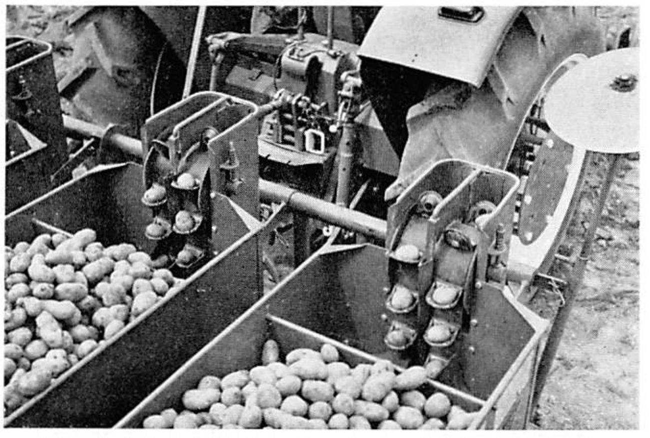


Fig. 3 (above) Automatic planters with two chains

Fig. 4 (below) An oscillating plate delivers the tubers into a vee belt.

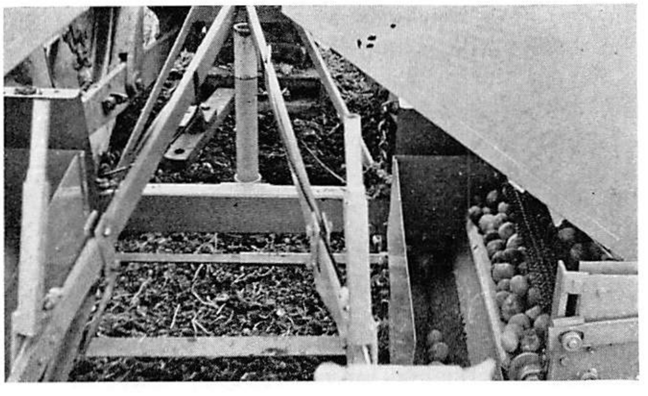
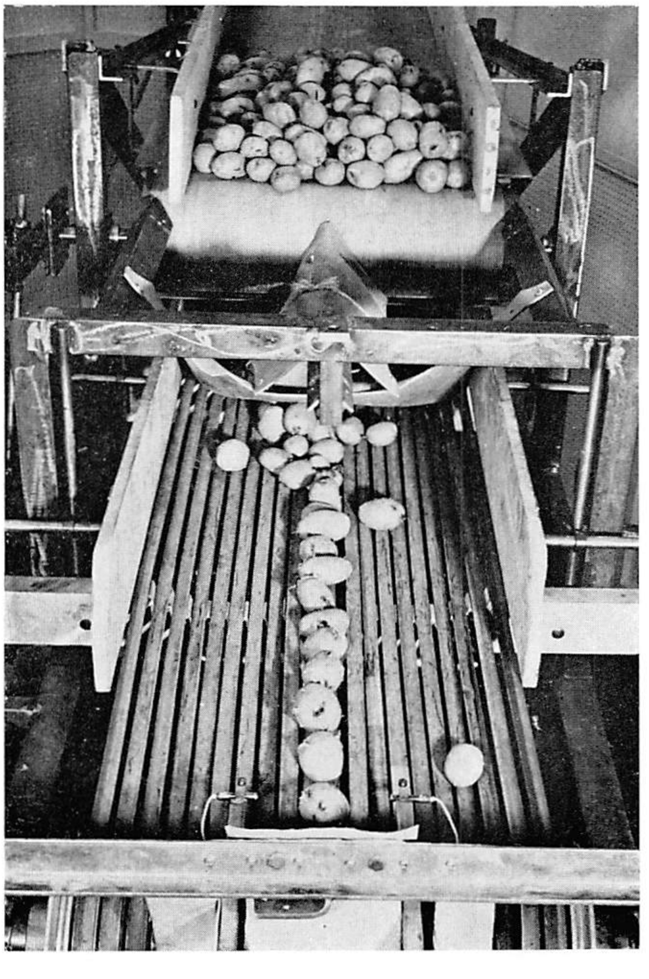


Fig. 5 (below) Laboratory research for better planting systems



Haulm Destruction

There are several reasons for destroying the haulm from the potatoes. Specially for seed-potato production haulm has to be destroyed before a certain date: This depends on the presence and flight times of aphids. In the event of a late attack of blight *(phytophthora infestans)* the haulm must be destroyed to prevent the disease spreading to the tubers and lastly haulm often cause many troubles during the mechanical harvesting process.

Haulm destruction can be done by chemical, mechanical and thermal means. The chemical method, spraying with eg *DNOC, DNOP* and sodium arsenite, all very poisonous materials, is well known and still the most common method. Often one spray is not sufficient to kill the haulm of a heavy crop completely.

There are two mechanical methods, the haulm pulverisers and the haulm puller. Haulm pulverisers are often used to reduce the bulk of haulm, to facilitate mechanical harvesting. The working part of the machine is often a horizontal axle with tines, flails or chains, the length of which are matched to the contours of the ridge.

The best method for destroying haulm for seed potato-production is to break the contact between the haulm and the tuber. For this work a haulm pulling machine should give the best results. This machine consists of two pneumatic counter rotating rubberised canvas rollers that run over the ridges. The rollers must pull out the haulm and keep the tubers in the soil. Up till now only the one row machines gave an acceptable result, but the difficulty is that these have a low capacity and produce many wheel tracks. Research is being done on machines for two and four rows but there are many difficulties in making a good working machine.

Much research is done on the burning of the potato haulm with a tractor mounted incinerator.

For a complete destruction from 300—1000 litres (66·19-220 gal) of oil per hectare (2·47 acres) are needed. One or two operations are necessary. Less oil, but more weight and water are needed, working with the steam principle developed by the Institute for Research on Storage and Processing of Agricultural Produce and the Institute of Agricultural Engineering and Rationalisation.

For the future the best way of destroying potato haulm will be the mechanical one, because of a low soil and air pollution and the direct breakage of contact between haulm and tuber. More research will be necessary on this subject.

The end of the crop mechanisation period, based on soil tillage, planting methods and haulm destroying must facilitate a harvesting method existing of lifting and transporting potatoes on every soil type and under every condition (except soils with stones) in such a way, that there will be as little damage to the tubers as possible.

Aspects Of Soil Preparation For The Potato Crop*

by E. F. Shotton†

A CONSIDERABLE extent of our own work on soil management stems from the very excellent insight which Dr van der Zaag gave me into the Dutch practices of cultivation in 1965. Similarly much of the progress which has been made by English farmers towards the objective of satisfactory mechanical potato harvesting with a reduced labour force is a result of ideas and even machines which came into the *UK* from the Netherlands.

Ten years ago it was a rather novel idea in England that the object of soil cultivation was not only to *grow* good crop of potatoes but also to bring the soil to a condition from which the crop could be harvested and separated with little or no hand labour on the harvester. Today this is accepted even though it is not always achieved on the more difficult soils. My experience has been with alluvial soils in eastern England with a content of 25 per cent to 40 per cent of clay particles (<0·002 mm [0·0008 in]); the remainder consisting of silt and very fine sand and with 2·5 to 3·5 per cent of organic matter. The problems of these soils, and more particularly of those with more than 30 per cent of clay, are:—

1) that frequently Winter frosts do not penetrate deeper than 5-8 cm (1·96-3·14 in);
2) that in Spring, even when tile-drainage has reduced the moisture content of the soil to field capacity, the soil below the frosted zone remains plastic and is not shattered by tined implements, and further delay in planting brings little improvement in this situation. In fact rain during April may make conditions more difficult, and
3) that in this condition, the soil is liable to compaction by tractor wheels, while wet soil brought to the surface by deep working implements will dry to form extremely hard clods.

Early experiments using zig-zag and/or reciprocating harrows to produce the seedbed and inter-row vee harrows to make more tilth between the rows were successful in reducing clod numbers but led to a reduced yield of saleable tubers. Traditional English deeper seedbed cultivations produced many more clods and led to the deeper formation of tubers in the broken but not tilthy soil and many of these were cut by the lifting share of the harvester. Under these conditions the best results were obtained by building ridges as soon as possible and using herbicides to control weeds.

Over the years 1961 to 1967 in 16 comparisons using five varieties of potatoes we showed a mean gain of 4·4 t/ha (1·76 t/acre) from reducing post-planting cultivations to a minimum and using herbicides for weed control as compared with cultivating to achieve weed control.

Table 1

King Edward 1967

Type of cultivation	*Total*	*Yields (t/ha) Saleable 3·8 cm (1·18 in)*	*Green 3·8 cm (1·18 in)*	*No. of clods * 145 kg (99·21 lb) soil in ridge June*	*Oct.*	*150 kg (110·23 lb) of potatoes at harvest*
Silty loam						
Traditional	40·6	31·5	3·1	25	16	200
Dutch	39·6	28·7	6·8	13	6	113
Sprayed	39·8	31·5	3·5	14	13	143
Silty clay loam						
Traditional	23·6	15·5	2·3	30	25	456
Dutch	33·6	19·6	8·3	14	6	107
Sprayed	35·0	24·8	3·3	15	13	237

** clods in June and October were larger than 3·8 cm (1·18 in), those at harvest larger than 3·5 cm*

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† Director, Terrington Experimental Husbandry Farm.

Table 2

Yields of Saleable Ware (tons/acre)

Trial No.	*Year*	*Variety**	*Traditional cultivations*	*Herbicide*	*Dutch-type cultivations*
1	1961	*KE*	10·9	12·7	-
2	1962	*KE*	12·1	14·4	-
3	1963	*KE*	10·7	12·0	-
4	1964	*KE*	11·8	15·2	-
5	1964	*PC*	11·3	14·0	-
6	1965	*KE*	11·6	11·8	10·3
7	1965	*PC*	16·1	18·6	17·8
8	1965	*M*	13·8	14·6	12·2
9	1966	*KE*	-	12·1	12·9
10	1966	*PC*	-	11·8	12·8
11	1966	*M*	10·5	11·0	11·1
12	1966	*M*	-	10·8	11·1
13	1966	*PD*	8·9	10·8	10·5
14	1966	*B*	8·8	10·1	8·0
15	1967	*KE*	12·4	12·4	11·2
16	1967	*KE*	6·2	9·9	7·8
17	1967	*KE*	-	13·0	13·0
18	1967	*PC*	-	19·0	20·2
19	1967	*M*	-	14·4	14·2
20	1968	*KE*	-	8·6	7·4
21	1968	*PC*	-	11·6	12·4

** B: Bintje KE: King Edward M: Majestic PC: Pentland Crown PD: Pentland Dell.*

This result was interpreted as indicating the damage done by cultivations.

On silt soils greening of the tubers tends to be troublesome and is one reason why tubers of the right size are rejected from the ware sample. Greening appears to be due to the ridges being too small to contain the developing crop and also because the surface of the ridges is liable to cap and subsequently to split in wide cracks down which light penetrates to the tubers after haulm destruction. A survey of farmers' practices showed that to reduce greening to a reasonable level ridges needed to have a cross-sectional area of 600 cm^2 (93 in^2) on silt soil with less than 4 per cent organic matter but that 400 cm^2 (62 in^2) was adequate on soils with more than that content of organic matter.

Our conclusions up to this point were published in the following practical recommendations to farmers:—

1. Good Spring cultivation begins with early ploughing under dry conditions in the previous late Summer (for silty clay loam) or autumn (silty loam).
2. Spring working prior to planting should be limited to the depth of frosted tilth.
3. After planting, ridges should be built as soon as adequate tilth, or tilth and small cobbles, is available.
4. If good ridges can be made before crop emergence, all cultivations should then cease, and the ridges should be sprayed with a residual herbicide just about the time the potatoes start to emerge.
5. If adequate ridges cannot be built before emergence, herbicides should not be used, but weeds must be controlled by cultivations. Even so the work should progress as quickly as possible so that it is completed by the end of May or, at the latest, during the first days of June.

The alternatives 4 and 5 were found to be necessary in practice and also arose as subjective deductions from set-piece experiments. If the ridge was insufficiently tilthy not only was there the problem of hand separation of clods at harvest but also the residual herbicides, which we favour for use in crops grown from pre-sprouted seed, were frequently not completely effective in controlling such weeds as cleavers *(gallium aparine)* which would emerge from beneath small clods if such were present in the surface of the ridge.

It must be admitted that at that stage, and even to date, we have not often succeeded in producing ridges sufficiently free from clods greater than 3·8 cm (1·4 in) (and thus capable of simple mechanical separation by sieving) to permit unmanned harvesters to function satisfactorily on our heaviest soils. Studies are in progress which attempt to ameliorate the problem of soil plasticity, and hence of clod formation in Spring, through the use of gypsum (calcium sulphate), small shingle and by other means but have not yet been brought to a conclusion. Farmyard manure at the rate of about 30 t/ha (12 t/acre) is already used as far as available on the heavy soil. The use of grass leys is not being studied: the information being that very short leys are of little or no benefit while leys of several years duration would be considered unacceptable by most farmers in the locality who keep little or no grazing livestock.

In this situation attention has been directed towards the testing of the newer cultivating implements. On the less heavy soils, and after a severe Winter, zig-zag harrows weighted so that the frame gives a scrubbing action, can produce a seedbed tilth of adequate depth and satisfactory quality. This is almost never the case on the heavier soils where if sufficiently deep penetration could be achieved draught would become too heavy causing compaction in the wheel tracks. The traditional "duck-foot" harrows and, even more so, spring tine harrows must be discarded as they bring up unweathered soil. Power driven implements combine the advantages of faster movement of the tines through the soil with reduced weight on the rear wheels of the tractor. On our relatively small farm (90 ha [222 acres]) we have until now had no tractor greater than 65 hp. The reciprocating harrow (Weidner) was found to give insufficiently deep penetration on the heavy soils and its work rate is slow. This year the vertically rotating rotary cultivator (Roterra) gave greatly improved results in a difficult spring after an almost frost-free winter. The traditional English rotary cultivator with hoe-blades (Rotavator) has not been favoured on our type of silt soil though it is liked on other soil types, but this year the makers have produced a spiked rotor which can be fitted to existing models at a very reasonable price. This Spring we have compared these machines in a trial to study their effects on seedbed depth and quality. (The reciprocating harrow excluded itself from this comparison by breaking down at the critical moment).

for the maincrop varieties grown in *UK* of 3·5 to 5 t/ha (1·40 to 2 t/acre). We have always been careful that we should not unknowingly sacrifice this considerable benefit in order to achieve some smaller economic gain through labour economy. To this end we have tried to keep in the forefront of our mind the fact that seed management and planting area is part of one process and that this in its turn is only a part of potato husbandry, the object of which is to make the largest possible profit for the grower. There is always a danger that in breaking down the processes in order to conduct manageable experiments one might lose sight of the fact that excellence in the performance of part of an operation may be, though perhaps rarely is, of no value or importance whatsoever.

The aspects of the seed/planter complex which we have investigated are:—

1) the effect of mechanical damage to the sprouts on yield, and ways of minimising any yield reduction;
2) the importance of regularity of spacing;
3) the value of speed in planting.

Table 3

No. of Clods per 50 kg (22·68 lb) of Soil in Ridge

		Seedbed prepared with				
		L-blade rotavator	*Spiked rotavator*	*Roterra*	*Roterra+ spiked rot.*	*Roterra twice*
Clods	>3·8 cm (1·49 in)	29	15	14	7	8
Clods	>3·2 cm (1·25 in)	63	43	37	23	21

The difficulty of preparing adequately large ridges free from clods can be eased if the rows are spaced more widely. Theoretically, in order to build a ridge of 600 cm^2 (93 in^2) cross-section at 75 cm (29·50 in) centres a depth of tilth of 8 cm (3 in) is needed. If the space between the rows is widened to 90 cm (35·43 in) only 6·6 cm (2·59 in) of tilth is needed. In practice both these depths will need to be increased but the principle remains and in practice the difference between the two depths is of importance. In our investigations into the use of 90 cm (35·43 in) rows we first established that when the seedrate was the same the yield was not reduced and in certain circumstances the ware yield was slightly greater than that from 75 cm (29·52 in) rows. In larger scale studies we have been able to show an improvement both in the condition of the ridges and in the workrate at harvest. The latter resulted partly from the fact that the length of row per unit area was reduced by 16 per cent when rows were widened from 75 cm (29·52 in) to 90 cm (35·43 in) and partly of the smaller number of clods which had to be separated. On both row widths the same single row harvester was used and it is clear that improvements in workrate can only occur if the harvester is working below its capacity in the narrower rows.

Mechanisation of Planting

Our work on this subject starts from our position of having established a benefit from pre-sprouting

Earlier experiments have demonstrated clearly the effect of seedrate on yield and have enabled us to give advice on the optimum seedrate and optimum spacing of seed of various sizes for the leading *UK* maincrop varieties. In all experiments concerned with the planting of seed tubers we have taken great care either to ensure absolute equality of seedrates between treatments or, if this was not possible because of the use of two or more planters in an experiment, to provide a means of "correcting" for any variation in seedrate. In cases where it seemed likely to provide additional information, more than one seedrate was used in an experiment. Closely graded seed, usually limited to a range of no more than 1·5 cm (0·59 in) (eg 3·7 to 5 cm [1·45 to 1·96 in] grade), has been used in most of the experiments referred to in order to ensure accuracy as regards seedrate and also to improve the operation of automatic planters.

Damage To Sprouts

Sprout damage was found not to be affected by sprout length.

Our own and other work has shown that optimum yields can be obtained by the use of sprouts about 1·5 cm (0·59 in) long; longer sprouts give no yield advantage but complicate planting; shorter sprouts tend to give lower yields. Sprouts of this length produced by a long sprouting period in a glass chitting house in which no heat is given except for frost protection are greener and tougher

Table 4

		Mean Apical Sprout Length									
	mm (in)	3·5 (0·13)	4·6 (0·18)	5·0 (0·19)	5·7 (0·22)	6·4 (0·25)	7·7 (0·30)	8·6 (0·33)	10·3 (0·40)	10·8 (0·42)	12·5 (0·49)	12·9 (0·50)
Percentage seed tubers with all sprouts removed or severely damaged		69	77	72	63	66	76	78	64	65	69	80

than sprouts of similar length produced during a short sprouting period under artificial illumination in an insulated store at 11-12°C. The older tougher sprouts suffer less mechanical damage and give higher yields.

Cup-fed planters of continental manufacture (Cramer or Hassia) have been shown to cause more damage to sprouts than the English belt-fed planter (Rotaplanter) which in turn caused greater damage than the hand-fed planter (Johnson).

Table 5

Sprout damage—per cent of Sets With all Sprouts Severely Damaged or Removed
Means 1969-1971

Planter	Long sprouting period	Short sprouting period
Hand-fed	17	25
Cup-fed	57	66
Belt-fed	36	44

Increased sprout demage caused delay in emergence.

Table 6

Crop Emergence—Number of Days from Planting to 75 per cent Emergence
Means 1969-1971

Planter	Long sprouting period	Short sprouting period
Hand-fed	30	33
Cup-fed	33	36
Belt-fed	31	33

In 16 trials over three years at Terrington *EHF* the increased sprout damage caused by an automatic cup-fed planter as compared with a hand-fed planter led to an average ware yield reduction of 2·1 t/ha (0·84 t/acre).

Regularity of Spacing

The belt-fed planter does not give perfect regularity of spacing and can give very irregular spacing if carelessly used. To investigate the importance of regularity experiments were started with two varieties, King Edward and Pentland Crown. Graded seed was planted at three mean spacings (20, 30 and 40 cm [7·87, 11·81, and 15·74 in] apart) in rows 75 cm (29·52 in), apart and, within each seedrate, at 4 degrees of regularity. These were calculated on the basis of the random pattern of seed tuber distribution measured over a number of crops on the *EHF* and on neighbouring farms: distribution curves were produced and from them random distribution patterns equivalent to 0, 20, 40 and 60 per cent coefficient of variation were produced. The exact position of each tuber for the trial plots was then determined and the tubers were planted with the aid of measuring tapes at their pre-determined positions in the plots. The work is still in progress but the average results for the two varieties in two years (averaged over the three mean spacings) indicate no difference between 0 and 20 per cent, a slight fall at 40 per cent and an appreciable reduction at 60 per cent coefficient of variation. The reduction is more evident in the ware grade than in total yield as the proportion of out-grades increased as irregularity became greater.

Speed of Planting

The time taken to complete planting will be determined by the forward speed at which the planter may be driven and the proportion of working time spent doing things other than actually planting the seed ie turning, filling the hopper etc. Because of these other operations, an increase in forward speed does not bring about a corresponding reduction in the time taken to plant the crop if these other operations are not also speeded up. The following table shows the area planted per day at the stated forward speeds assuming that it takes 1 min for 50 kg (110 lb) of seed to be loaded from sprouting trays or bags into the hopper of the planter; that the seedrate is 2·5 t/ha (1 t/acre); that the potato rows are 75 cm (29·52 in) apart and 300 m (328 yd) long; that each turn takes ¾ min; that, in a working day of 10 h, 1 h is lost through breakdowns; and that 15 per cent "relaxation allowance" should be made.

In fact, on these assumptions, the faster the forward speed the fewer the minutes in each hour which are spent in actually planting the crop. These rates could be improved by a considerable margin for the faster automatic planters if filling time could be reduced from 1 min/50 kg (110 lb) to 3 min/500 kg (1102 lb).

To achieve an improvement of filling time of this order seed would need to be handled mechanically in bulk. Current experiments are comparing the sprouting of seed in 500 kg (1102 lb) pallet boxes under a polythene structure, with sprouting in trays in various types of sack in the same structure, and

Table 7

Effect of Uneven Planting on Yield
(Average of Pentland Crown & King Edward 1970-1)

Coeff. of variation (per cent)	0	20	40	60
Total yield (t/ha)	51·1	51·1	50·8	50·1
(t/acre)	(20·44)	(20·44)	(20·32)	(20·04)
Ware yield 4·4-8·3 cm (t/ha)	38·6	38·2	37·9	36·9
(1·73-3·49 in) (t/acre)	(15·44)	(15·28)	(15·19)	(14·76)

Table 8

Typical Workrates (per 10 h day) at Different Forward Speeds

No. of Rows	*Forward speed* 2	4	6	8	10 km/h
	(1·24)	(2·49)	(3·73)	(4·97)	(6·21) (miles/h)
2	1·7	2·8	3·4	3·9	4·3 ha
	(0·68)	(1·12)	(1·36)	(1·56)	(1·72) (acres)
4	2·9	4·2	5·0	5·5	5·9 ha
	(1·16)	(1·68)	(2·00)	(2·22)	(2·36) (acres)

Table 9

Area Planted per day on the Foregoing Assumptions Except for Variation in Filling Time
(2-row machine)

Forward speed		1 min/50 kg (110 lb)		3 min/500 kg (1102 lb)	
km/h	(miles/h)	ha	(acres)	ha	(acres)
2	(1·24)	1·7	(0·68)	2·0	(0·80)
6	(3·73)	3·4	(1·36)	5·0	(2·00)
10	(6·21)	4·3	(1·72)	7·1	(2·84)

with sprouting in a bulk heap in a frost-free barn. Two varieties, King Edward and Pentland Crown, which have somewhat differing sprouting requirements, are being used and records of sprout damage, rate of emergence and yield will be taken.

Faster planting allows the farmer to choose either to start at the same time and finish sooner or to delay his start with the object of planting the bulk of his acreage as close as possible to the occasion when he judges soil conditions to be ideal. Farmers on different soils might be expected to choose somewhat differently. Information on the effect of date of planting on yield is not over-abundant and almost all relates to hand planting. While many farmers will readily accept the idea that fast planting is desirable, the *direct* advantage in some cases (as where only a small acreage is to be planted) will be minimal. In other cases it seems possible that changes in sprouting system, increased sprout damage or irregularity of spacing which might be the concomitant of faster planting could, through adverse effects on yield, nullify any such advantage. Moreover, if faster planting is adopted, the choice of whether to plant earlier or to aim for ideal soil conditions should perhaps be influenced by the condition of the seed and the extent to which the sprouts might suffer damage.

We are therefore engaged in a further series of trials involving three planting dates spanning the

→ page 42

month of April, three sprouting regimes and two types of planter. The first year's results showed that the highest yield came from planting seed with old, tough sprouts with a hand-fed planter in mid-April.

But such a simple answer can no longer be accepted as satisfactory. Quite apart from the fact that this year's trial shows every likelihood of giving a different result, this answer hardly begins to take account of the numerous factors I have outlined above. Each factor is likely to vary in importance from farm to farm. It is no part of our thinking to assume that we shall eventually come up with the one ideal system of seed potato handling and planting for the *UK* or even for East Anglia. Our hope is that our experiments will provide a foundation of facts upon which a farmer may draw to help him to decide what pattern of sprouting and planting will best suit his farming system. Our present evidence indicates that yields in many farming situations will be maximised by planting seed with tough old sprouts through a hand-fed planter. We are aware, that even on this basis this advice will be inappropriate to some, possibly many, farms. We are equally aware that maximising yield does not necessarily mean maximising profit. But we would suggest that for this crop for which costs and returns are at such a high level it would probably need a major reduction in the farm work force rather than any variation in the planting arrangements to justify any target other than maximum yield.

Edited Summaries of Discussions – Day 2

Discussion Papers 1, 2 and 3

Mr J. M. Glotzbach stated, in reply to a question from Mr Walsh (Irish Sugar Co.) that the only control the Commodity Board wanted in the *EEC* market was a uniform quality standard and protection against imports at dumping prices.

Mr J. Smith asked if the use of 90 cm (36 in) rows would alter the relative yield advantage of herbicides versus cultivations for weed control.

Mr F. E. Shotton replied that in the small experiments tried there was very little change indeed.

Mr I. Rutherford (*ADAS*) asked how the damage incurred by tubers during planting was measured when trying to compare different mechanisms.

Mr G. V. Poesse replied that damage to tubers was not measured but only the breakage of sprouts.

Mr F. Coolman asked whether in *UK* trials the loss of yield due to sprout damage of planting persisted right through to maincrop harvest time or if, as in Dutch trials, the biggest losses were found when harvesting early, say for seed in July and this loss had almost disappeared by Autumn.

Mr F, E. Shotton confirmed that the drop in yield was found in October harvested crops but felt sure that late varieties such as Pentland Crown had not completed their growth by that time.

Mr G. Spoor (*NCAE*) asked if any thought had been given to the Autumn preparation of potato seed beds.

Mr G. J. Poesse said some research had been done in the Netherlands but there appeared to be no advantage in making ridges in Autumn and planting in Spring and often the ridges were washed down by Winter rain and because of the finer soil drying was delayed.

Mr F. E. Shotton added that this had been tried at Terrington on a number of occasions with little or no advantage.

Mr R. A. den Engelse asked about consumer preference for

→ *foot page 43*

Recent Developments In Potato Harvesting Machinery*

by D. C. McRae†

A TURNING point was reached in potato harvester design when it became practical, using x-rays as a means of differentiation, to separate potatoes from stones and clods efficiently. Until this development, separating systems depended on exploiting differences in the external characteristics such as shape, density and moment of inertia of potatoes on the one hand and stones and clods on the other. Examples include:—sloping conveyors with or without dimpled surfaces designed to exploit shape characteristics, but failing to do so with round stones or clods; nylon brushes with bristles stiff enough (by virtue of their angular velocity) to support potatoes but not some round stones and clods—again failing when flat stones are encountered; a combination of brushes and belts with gaps between them to allow unwanted material to escape—employing shape and moment of inertia and somewhat successful in *USA* and flotation in soil water suspension—completely successful mechanically but a failure because of the poor keeping quality of mud-covered potatoes.

With the exception of the last example, most separators at best merely divide the presented material into two portions, the first having a high ratio of potatoes to unwanted material and the second with the proportions reversed. This can simplify the task of operators carried on the machine.

The advent of the x-ray separator underlined the severe limitations of mechanical separation and with the possible exception of new flotation techniques, future developments in fully automatic harvesters will in all probability hinge on improved electronic separating systems. An appraisal of the x-ray system led to the conclusion that it was worthwhile to seek simpler alternatives, whilst adhering to the principle of using an electronic scanning method.

** Presented at the Commission Internationale du Genie Rural and the Institution of Agricultural Engineers Joint Autumn National Meeting at the National College of Agricultural Engineering, Silsoe, Bedfordshire, on 3 October 1972.*

† NIAE, Scottish Station.

concluded from page 42

particular potato varieties in terms of white or yellow fleshed potatoes affecting import export movements between countries.

Mr **J. M. Glotzbach** said that in *UK* and Ireland the preference is for white fleshed potatoes and on the continent for yellow fleshed. In his experience however, it was not difficult to sell yellow fleshed varieties in countries where white flesh is normal, but it is very difficult to reverse this process even when very high quality potatoes are offered such as King Edwards.

The use of gamma radiation from a suitable radioactive isotope in conjunction with Geiger Mûller detector tubes was considered a workable alternative to the x-ray method. A prototype separator was built to investigate the practicability of the scheme.

Gamma radiation consists of short pulse radiated energy of extremely high frequency, with a penetrating power dependent on the specific isotope used. The radio element Americium produces gamma rays similar to x-rays in penetrating power and sources of this material having suitable strength are available.

The gamma pulses are produced at a random rate and must be emitted in sufficiently large numbers to enable the electronic circuit to distinguish between the longer time interval, due to greater attenuation by a stone or clod and the natural time interval governed by the emission rate. The Americium source chosen has an energy level of 60 KeV. The decrease in count rate/min of the emission when obstructed by a potato, clod or stone of the same size is shown in Fig 1. (page 44).

Description of the Separator

Capsules containing 45 mCi of Americium with individual collimators, are mounted on a source bar inside a steel shield tube with apertures. The source is "on" when the bar is moved so that the sources register with the apertures. A small hydraulic actuator ensures that when the separator is not working, the sources are caged.

The separator has two presentation decks and two sets of sources with detectors linked through an electro-hydraulic circuit to rejector flaps. Each presentation deck consists of two chains carrying moulded rubber grading spools whose shafts are located in spigot bearings carried by the chains. Travelling cells in which objects may lie, or fall through for presentation on the second deck, are formed by the mouldings and stationary guide bars. The mixture of potatoes, stones and clods falls onto the deck and forms into lanes of objects which pass through the gamma ray beams. Objects above 4·4 cm (1·75 in) size pass along the upper deck whilst smaller objects fall through and are carried to the second deck which has 3·2 cm (1·25 in) aperture cells. By separating the mixture into two distinct size grades, the separating unit has to deal

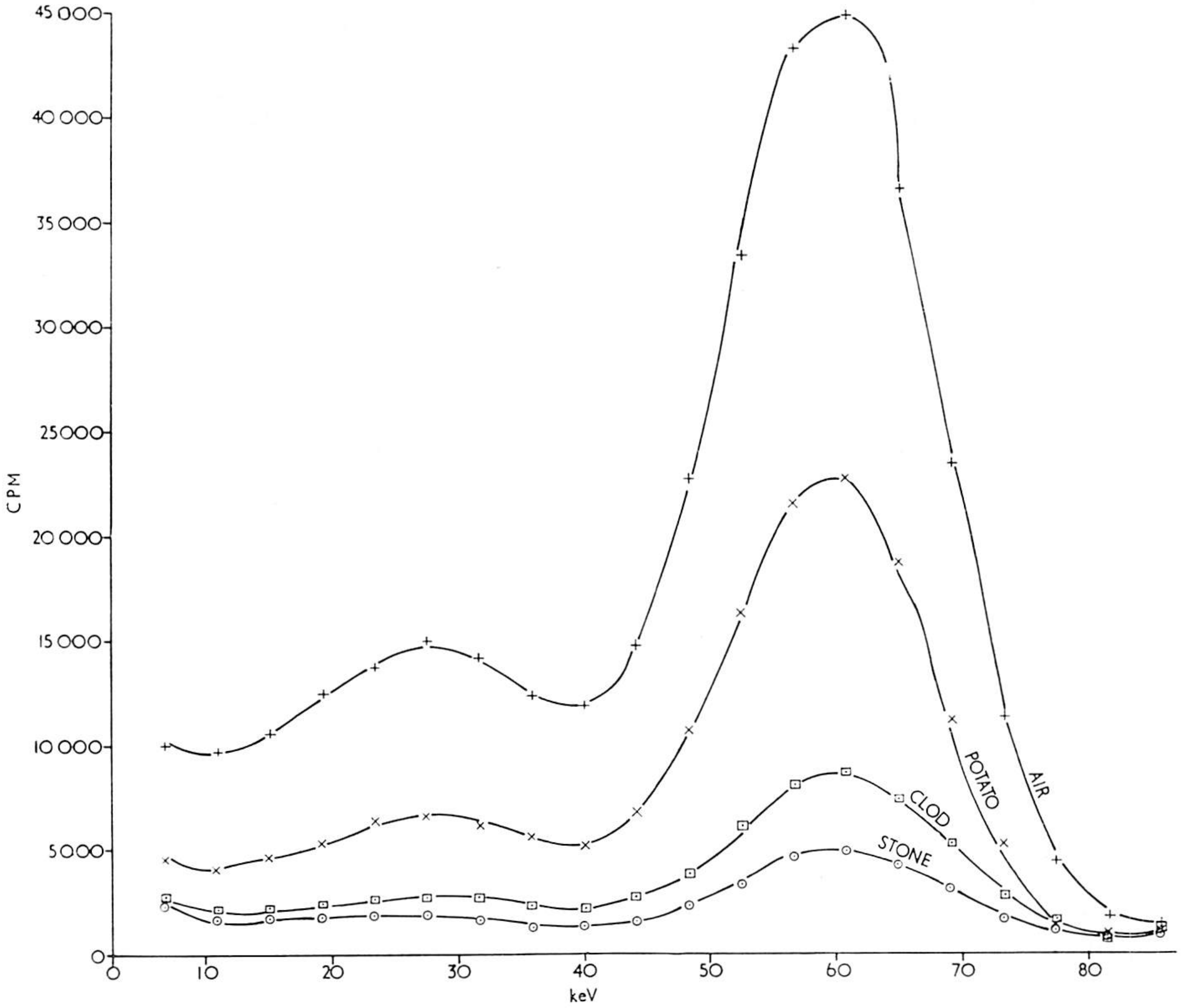


Fig. 1

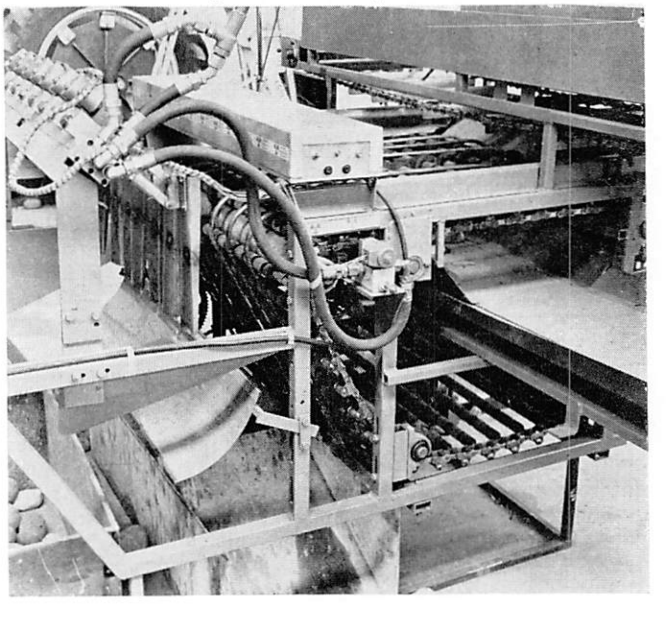
with a much narrower object size range and errors are minimised.

When a stone or clod passes through a gamma ray beam, a detector tube in the electronic circuit box mounted above the deck responds to the change in gamma ray rate reception and a signal is passed to a hydraulically operated rejector flap via a solenoid valve (Fig 2). Resetting of the system is achieved by a reset pulse from a cam operated microswitch. Where two stones or clods follow in succession, the resetting pulse is inhibited to minimise wear in the flap actuating mechanism. To achieve maximum inspection time, the deck is driven by an eccentric sprocket giving a ratio of inspection to idle time of 3:1.

Performance

So far, only the larger grading size presentation deck has been tested. An efficiency of 94-96 per cent has been achieved. An estimate of potential performance based on the maximum operating rate suggests a capacity in a 12 t crop, with a typical mixture of 65 per cent potatoes on the presentation decks, of 0·445 ha (1·1 acre). Allowing 20 per cent turning time, an output of 3·56 ha (8·8 acres) /10 h

Fig. 2 Gamma separator.



day is theoretically possible. The actual rate achieved will depend on the cell fill on the decks and the extent to which other parts of the machine begin to limit throughput.

Effects of Radioactivity

If the current experiments prove successful and eventual manufacture of harvesters with gamma ray separators is contemplated, a new situation will be created—the general use of radioactive materials on the farm. Since the ultimate success of the system described is bound up with the question of safety on the farm, careful consideration must be given to the potential hazards to crops and farm workers.

The effect of gamma radiation on potato tubers is to inhibit sprouting but only when the dosage of radiation is of the order 10,000-20,000 rads[1]. Dosage received by passage through the separator is $0{\cdot}7 \times 10^7$ rad. An energy level of 1·3 MeV is stated as being harmless to foodstuffs. The Americium source energy level is 60 KeV. The permitted radiation limit cited in the Food (Control of Irradiation) Regulations 1972 is 50 rad at 5 MeV.

The dosage received by a worker (with large hands, capable of spanning two sources) who places both hands on the sources, is 3 m rad/h. The Factories Act permits a dosage of 12 m rad/h.

From the foregoing figures it is clear that there is very little danger associated with this particular isotope if used in the way intended. Nevertheless, some form of control would be necessary, so that, to take the extreme case, source bars were not left lying around the farm yard. Since the half life of Americium sources is 458 years, they would be for all practical purposes unchanged when the harvester was worn out. The cost at present prices of 16 sources required for a twin deck separator would be about £800. It is suggested that an ideal scheme to minimise the capital outlay for the farmer and ensure close control over distribution and safe keeping of sources, would be to hire the sources and recall them at the end of each season for a nine month storage period at a suitable depot. This would allay any public fears regarding indiscriminate handling of potentially dangerous material. At a reasonable hire rate for the sources, there is a real likelihood that a harvester using gamma separation could be cheaper and less complex than present electronic machines. Standard tractor hydraulic systems can power the deflector flap circuit, whilst the entire electronics system can be operated from the tractor battery. Continuous levelling of the presentation decks will not be necessary.

Transfer of Potatoes from Harvester to Trailer

Whilst it is recognised that the major proportion of damage done at harvest time occurs on the harvester during digging, riddling and separation prior to discharge into the trailer, up to 8 per cent severe damage can be attributed to handling from harvester to store. The problem of damage within the harvester is complex, but there is an opportunity to bring about a marked reduction in damage done during transfer from the discharge conveyor on the harvester to trailers or boxes and again when these are emptied at the store.

In Autumn 1971 a photographic survey of three makes of harvester on eight farms in East Lothian, was made to determine typical transfer conditions from harvester to trailer. It was found that when the trailer began to fill (the most damaging stage) mean drop height was 78 cm (30·8 in) decreasing to 49 cm (19·3 in) as filling continued. There is evidence that drop heights in excess of 47 cm (18·5 in) produce damage[2].

A potato harvester discharge conveyor was constructed and fitted with an automatic height control system. Chief considerations in the design were:—the need to ensure rapid response to the relative movements of harvester and trailer; the desirability of permitting downward movement of the conveyor when moving from a high point of the pile of potatoes to a lower point and the necessity to allow the conveyor to swing clear in the event of impact against high sided trailers or boxes.

The layout of the prototype, built on a trailer to permit manual loading during tests is shown in Fig 3.

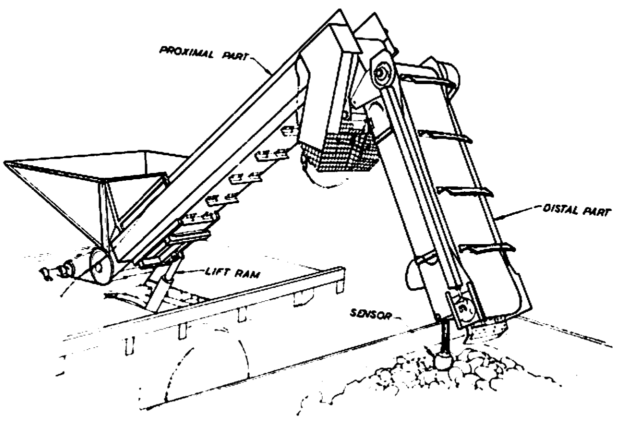


Fig. 3

The conveyor is in two parts connected by a joint which allows the distal part to swing sideways if it should make contact with boxes or trailer sides. The drive is maintained to the distal part by taking a vee belt drive through the axis of rotation. The proximal part of the conveyor is hinged on the harvester to permit vertical movement. Since the distal part works in an almost vertical position, the conveyor belt fitted with long flights operates in the manner of a bucket conveyor, lowering potatoes gently down the chute. Rotation is contrary to the direction of the proximal conveyor.

The sensor on the distal end of the conveyor consists of a rubber ball connected by a tube to an air-switch. This in turn is used to trigger a relay in a control box. A lift ram is actuated by a solenoid valve connected to the control box. A transistorised variable time delay (1·5—3·0 s) ensures a lift of 12·5 cm (5 in) before the circuit switches to lower. In operation the conveyor rises and falls as the pile in the trailer builds up. The lower part of the cycle

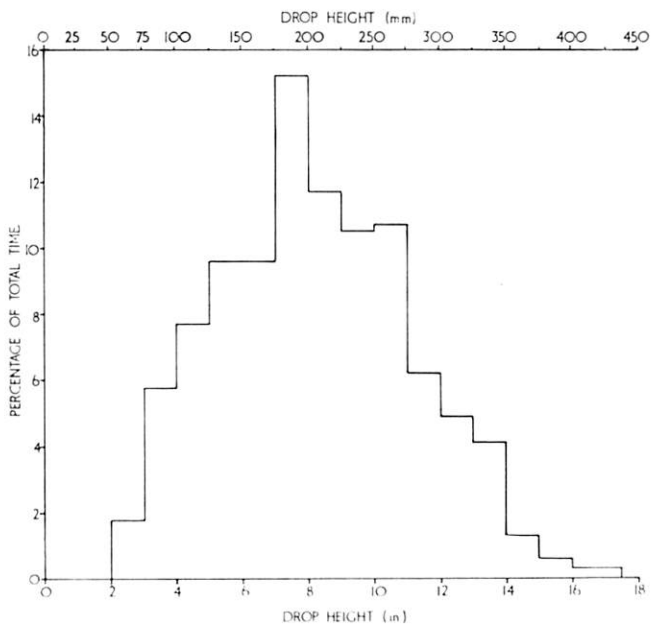


Table 1 (above)

Fig. 5 (top right) Conveyor in raised position.

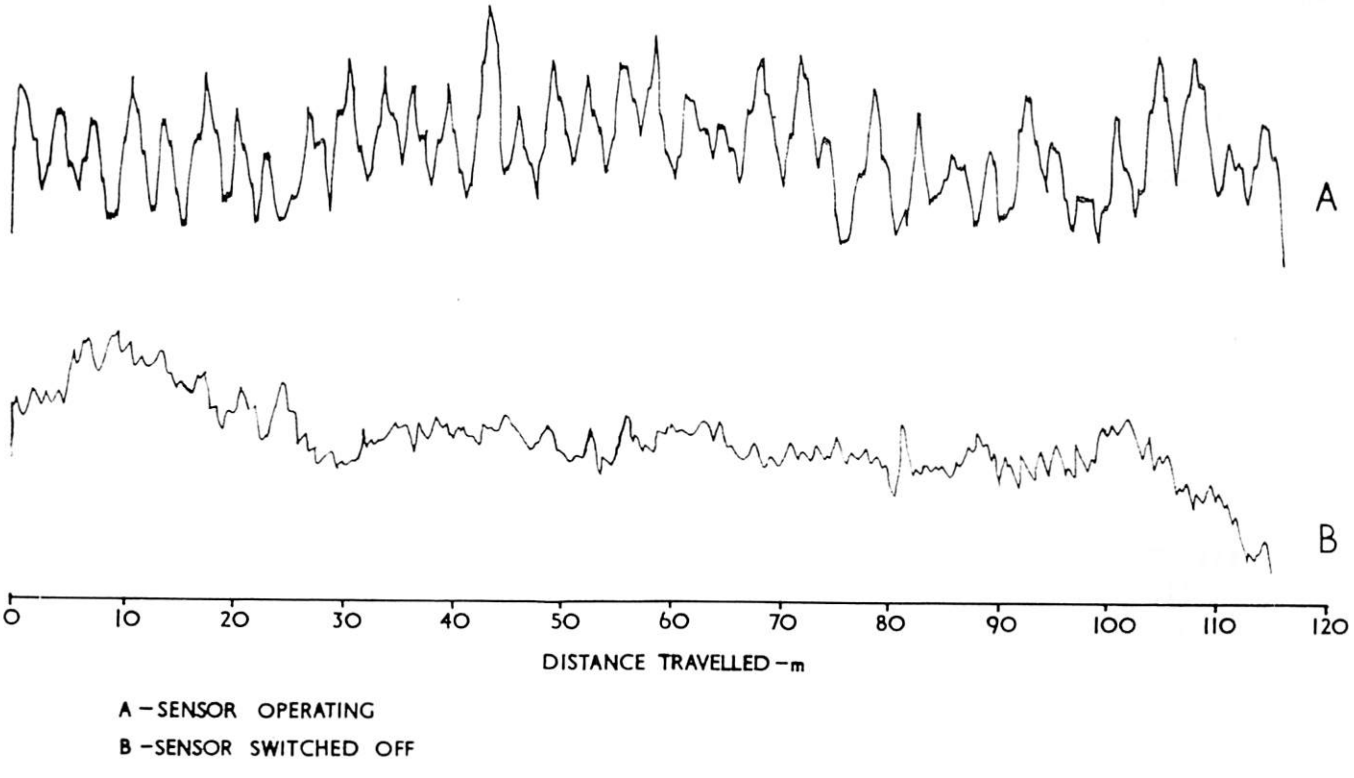
ensures that potatoes themselves fall the minimum distance wherever the point of discharge may be.

A switch on the control box permits manual lifting and lowering of the elevator. The hydraulics system has a flow control valve to enable adjustment of the lifting rate to be made for different tractors and engine speeds, whilst a needle valve is used to alter lowering rate.

→ *foot page 47*

Fig. 4 (below)

Fig. 6 (right) Conveyor slewed to one side.



Performance Assessment of Potato Harvester Systems*

by I. Rutherford†

Summary

A JOINT *ADAS/PMB* investigation studied 30 models of complete harvesters throughout Britain in 1971. Field performance of eight types of machine was measured on 192 farms. Record cards provided data on long term rates of work on 249 machines. Leavings, crop damage and crop contamination were measured. The main findings of the survey were as follows:—

1. Potential machine performance was satisfactory but not exploited to the best advantage on many farms.
2. Transport from the field seriously reduced harvester output from many potentially high capacity systems.
3. Most machines left 1·25 t/ha (10 cwt/acre) in the field, and this loss plus up to 5 per cent of damaged tubers represented a financial loss of about £62·50/ha (£25/acre) on many farms.

Introduction

The life blood of an extension service is reliable up-to-date information, and for this reason the Mechanisation Department of *ADAS* collects machine performance data on which advisory programmes can be based. This paper deals with the investigation carried out in 1971 by *ADAS* mechanisation officers in conjunction with the *PMB* and the Scottish colleges.

The objectives of the study were to provide information as follows:—

a. To obtain performance data for current machines over a range of soil types convering the most important potato growing areas.
b. To assess levels of severe crop damage and leavings on each farm.
c. To investigate the relative economic importance of machine costs compared with crop losses.

The Sample

In less than 15 years the use of complete harvesters in Great Britain has increased from 3 per cent to 49 per cent of the acreage as shown in Table 1. In view of the trend towards fully mechanised systems, the survey was confined to farms using complete harvesters. A recurring problem of collecting machine performance data is the difficulty of being up-to-date. For this reason only machines of less than three years old were studied, but in spite of this, due to continuing improvements

→ page 48

* *Presented at the Commission Internationale du Genie Rural and the Institution of Agricultural Engineers Joint Autumn National Meeting at the National College of Agricultural Engineering, Silsoe, Bedfordshire, on 3 October 1972.*
† *ADAS, NIAE.*

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Results of Tests

Drop heights for potatoes were determined manually by holding the end of a datum line level with the landing point of potatoes in the trailer. The other end of the line passed round a drum connected to a rotary potentiometer. Signals from the potentiometer were recorded on magnetic tape and later analysed by computer after conversion to punched tape.

In Table 1 the percentage total time for a typical run is plotted against drop height. The mean drop height was 20·8 cm (8·19 in) with a standard deviation of 7·4 cm (2·92 in).

It was originally thought that height variations between the discharge point of the conveyor and the pile of potatoes in the trailer would occur at a rate exceeding the correction rate of the height control system. In practice this has not been the case. In Fig 4*A* a *UV* recorder trace shows the operating patterns over a known distance when the sensor is switched on. Trace *B* shows the variation in height due to ground undulations over the same distance.

Conclusion

It is possible to bring about a market reduction in drop height using the equipment described. Field tests of a second prototype (Fig 5 and 6) fitted to a harvester and operated under normal commercial conditions have been satisfactory so far. Further trials and damage assessments are being conducted in the maincrop harvest this Autumn.

References

[1] **Kohle, J., Zentner, R. D. and Lukens, H. R.,** Radioisotope Engineering, Van Nostrand Co. Inc.

[2] **Tabachuk, V. I.** An investigation into the susceptibility of the potato tuber to damage on impact. Leningradskū selkoz Inst. Zap. 1953 (7) 90-99 *NIAE* Translation 130.

and new models, some of the machines are now obsolete.

Table 1 **The Increasing Use of Complete Harvesters 1958-70***

Year	*Potato acreage Great Britain*	*Average acreages of PMB registered growers*	*Percentage of Acreage Lifted*			
			Plough	*Spinner*	*Elevator digger*	*Complete harvester*
1958	289,200 ha (723,000 acres)	3·8 ha (9·5 acres)	5	72	20	3
1963	276,800 ha (692,000 acres)	4·1 ha (10·2 acres)	6	45	32	18
1968	243,200 ha (608,000 acres)	5·1 ha (12·7 acres)	3	25	33	39
1970	236,000 ha (590,000 acres)	5·5 ha (13·7 acres)	-	15	36	49

**PMB Crop Production Survey*

In view of the decline of the hand picking gang, this investigation was confined to the latest complete harvesting systems using machines up to three years old. Most manufacturers adopt a policy of continual development and improvement with the result that several of the machines studied are now obsolete although they are only two to three years old. The investigation draws attention to weaknesses of earlier design and the farmer must satisfy himself that the new models have overcome them. The machines were selected from the *PMB* Crop Production Survey of 2,000 farms.

Machine Classification

The types of machines investigated are shown in Fig 1.

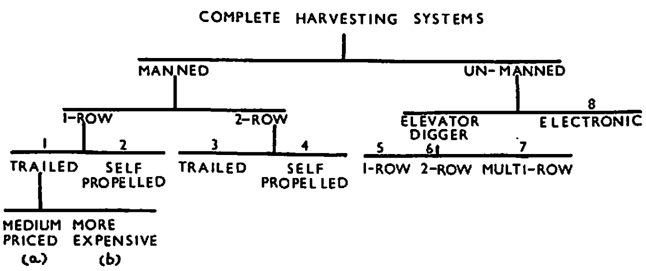

Fig. 1 Machine classification.

Row Width

In spite of the much published benefits of wider rows, over 75 per cent of the harvesters were working on 11·02 and 11·81 cm (28 and 30 in) row spacings. Furthermore, there does not appear to be any rapid trend towards wider rows as shown by Table 2 which compares all the machines with the newest purchased in 1971.

Table 2 **Distribution of Harvesters by Row Width**

Row Width cm (in)	71 (28)	76 (30)	81 (32)	91 (36)
Percentage of all harvesters (No. of machines 192)	20	57	6	17
Percentage of 1971 (No. of machines 57)	21	53	10	16

Machine Utilisation

General

The data on machine utilisation is based on analysis of the record cards filled in by the drivers each day. The cards were examined carefully and if they were not complete, or if the records covered less than 4 ha (10 acres), they were excluded.

Acres per Season

Shortage of labour appears to be forcing farmers to use complete harvesters on very small acreages. The machines have been grouped as Fig 1. Any group with less that ten machines has been excluded due to the large variation between farms. The acreage harvested per season for each group is shown in Table 3.

Table 3 **Distribution of the Sample by Seasonal Utilisation in Hectares (Acres)**

	Machine type		*Group*	*Number*	*Hectares (acres) Harvested per Season percent of Each Machine Type in Each Band*						
					4-7 (10-19)	8-12 (20-29)	12-16 (30-39)	16-20 (40-49)	20-24 (50-59)	24-28 (60-69)	28 ha (70 acres)
MANNED	ONE ROW *Trailed*	*Medium Priced*	1A	30	27	30	30	3	10	–	–
MANNED	ONE ROW *Trailed*	*More expensive*	1B	112	32	24	14	12	7	8	3
MANNED	*TWO ROW-Trailed*		3	10	–	–	–	20	20	10	50
UNMANNED	*TWO ROW*		6	18	11	6	17	–	22	6	38

Table 4 Percentage Distribution of the Sample by Seasonal Utilisation in Hours

		Machine type	Group	Number	Working hours per season: 50	50-99	100-149	150-199	200-249	250
MANNED	ONE ROW	Trailed	1A	32	3	25	56	7	6	3
MANNED	ONE ROW	Trailed	1B	108	6	34	28	18	8	6
MANNED	TWO ROW	Trailed	3	11	–	27	28	–	9	36
UNMANNED		TWO ROW	6	18	17	17	28	11	–	27

Duration of the Potato Harvest

There is little information on the amount of time available for root harvesting, but records of hours worked were kept in this study for 1971 which was a dry Autumn in the main potato growing areas of the country. The amount of time spent by the machine in each group is given in Table 4 which again excludes any group with complete records for less than ten machines.

Machine Performance

Method

During the 1971 harvest 192 machines were studied in detail. The machines were operated under a wide variety of conditions, and the aim was to obtain performance figures for the whole range of machines on the market.

Most of the harvesting systems were observed for 2-3 hours, and during this period all the relevant details were recorded. The yield of the crop was assessed by *PMB* officers just before the performance assessment. The area lifted and all delays were recorded to obtain data on the large number of factors influencing field performance.

Spot Rate of Work

Definition

The spot rate of work is calculated from the forward speed and the effective width of the machine.

Table 5 Forward Speed and Spot rate of Work by Machine Type

Type	*Number*	*Speed*	*Spot rate of work*
1A Manned 1-row, trailed, medium priced	29	1·94 km/h (1·21 miles/h)	0·14 ha/h (0·36 acres/h)
1B Manned 1-row, trailed, more expensive	98	2·20 km/h (1·37 miles/h)	0·17 ha/h (0·43 acres/h)
Manned 1-row, self propelled	7	2·18 km/h (1·36 miles/h)	0·17 ha/h (0·44 acres/h)
Manned 2-row, trailed	15	1·81 km/h (1·13 miles/h)	0·30 ha/h (0·75 acres/h)
Unmanned 1-row	2	2·83 km/h (1·76 miles/h)	0·24 ha/h (0·62 acres/h)
Unmanned 2-row	26	2·54 km/h (1·58 miles/h)	0·36 ha/h (0·98 acres/h)
Unmanned 4-row	5	2·22 km/h (1·38 miles/h)	0·70 ha/h (1·76 acres/h)
Unmanned Electronic	9	1·74 km/h (1·65 miles/h)	0·20 ha/h (0·51 acres/h)

These results point to the importance of maintaining forward speed for satisfactory rates of work. The influence of the hand sorters is possibly contributing to the higher rate of work with the more

$$\text{Spot rate of work ha/h (acres/h)} = \frac{\text{Speed km/h (miles/h)} \times \text{Effective width m (ft)}}{K}$$

Where K = 16·3 when using metric units and 8·25 when using imperial units

This represents the theoretical potential achieved during the observation, and provides a useful basis to compare speed of operation and rate of work excluding complications of turning at the headland and other delays caused by man or machine.

expensive single row machines most of which have more sophisticated mechanisms for clod and stone separation. The tendency is for those picking on the machine to dictate the forward speed, and it is significant that the average speed of all the unmanned machines was over 20 per cent faster than manned machines.

➔ *page 50*

The Effect of Row Width

One of the advantages claimed for wider rows is the increased rate of work. This can accrue either from the fact that there are less rows per acre, or that it is easier to drive faster, or a combination of both. The speeds and spot rates of work of the machines in the most numerous group, 1*B*, are shown in Table 6.

Table 6 The Influence of Row Width on Forward Speed and Spot Rate of Work

Row Width	*Number*	*Speed*	*Spot rate of work*
71 cm (28 in)	21	1·77 km/h (1·18 miles/h)	0·13 ha/h (0·33 acres/h)
91 cm (36 in)	16	2·39 km/h (1·49 miles/h)	0·21 ha/h (0·54 acres/h)
All machines	99	2·20 km/h (1·37 miles/h)	0·17 ha/h (0·43 acres/h)

These figures suggest that there is in fact a real advantage to be gained from wider rows. The forward speed of the 91 cm (36 in) row machines was 10 per cent faster than the average for the whole group, and 25 per cent faster than the 71 cm (28 in) row machines. With fewer rows/ha (acre), the advantage in spot rate of work was about 25 per cent over the group as a whole, and over 60 per cent as compared with the machines on the narrowest rows.

Net Rate of Work

Having measured the spot rate of work to compare rates of work in absolute terms, an attempt was made to compare the performance which was obtained over a longer period of time. This presented considerable problems due to the fact that resources were limited and only a certain amount of time could be spent on each farm. Provided the system is operating smoothly, a representative result can be obtained in a short period, but in the event of a delay in the harvesting operation on one farm, and no delays on the next farm, comparison of the two systems becomes difficult. To overcome this problem, delays due to breakdowns, blockages or lack of transport have been excluded to calculate a net rate of work for each machine.

$$\text{Net rate of work ha(acres)/h} = \frac{\text{Hectares (acres) harvested}}{\text{Recorded time} - \text{delays (h)}}$$

Time spent turning at the headlands is included in the net rate of work.

Seasonal Overall Rate of Work

Data on long term rates of work was also collected in this investigation. The machine operator recorded the hours that the harvester was actually working, and acreage covered each day throughout the season. Delays and breakdowns were also recorded, and at the end of the season the seasonal rate of work was calculated.

$$\text{Seasonal rate of work ha(acres)/h} = \frac{\text{Total hectares (acres) harvested}}{\text{Hours worked} - \text{delays and breakdowns}}$$

The reliability of these records depends entirely on the driver, but the large numbers of cards were kept conscientiously. Those with omissions or suspect data were discarded. Table 7 below allows comparison of the alternative methods of expressing the machine performance and the inter-relationship between some of them.

Breakdowns and Delays to the Harvesting System

General

The ratio of the spot rate of work to the net rate of work is a measure of the efficiency of field operation, and at 75 per cent, a typical figure from Table 7, the operation of the machines would appear to be satisfactory. The long term rates of work are disappointing, however, with seasonal rates of work for the unmanned harvesters less then half the spot

Table 7 **Summary of Performance Measurements**

		Machine Type		*Group*	*Spot ha/h(acres/h)*	*Net ha/h(acres/h)*	*Net as percentage of spot*	*Seasonal overall*	*Seasonal as percentage of Spot*	*Net*
MANNED	*ONE ROW*	*Trailed*	*Medium priced*	1*A*	0·14 (0·36)	0·10 (0·26)	72	0·09 (0·24)	67	92
			More expensive	1*B*	0·17 (0·43)	0·12 (0·32)	74	0·10 (0·27)	63	84
		Self-propelled		2	0·17 (0·44)	0·14 (0·37)	84	0·11 (0·28)	64	76
	TWO ROW	*Trailed*		3	0·30 (0·75)	0·40 (0·61)	81	0·18 (0·46)	61	75
		Self-propelled		4	-	-	-	-	-	-
UNMANNED	*ONE ROW*			5	0·24 (0·62)	0·18 (0·47)	76	0·10 (0·25)	40	53
	TWO ROW			6	0·39 (0·98)	0·26 (0·65)	66	0·17 (0·44)	45	68
	FOUR ROW			7	0·70 (1·76)	0·46 (1·15)	65	NR	-	-
	ELECTRONIC			8	0·20 (0·51)	0·12 (0·38)	75	0·10 (0·26)	51	68

The Annual Conference of the IAgrE is entitled The Handling, Treatment and Disposal of Farmwaste. Details on page 63

rate of work, and apparently consistently worse than the manned machines. The factor affecting the difference between the net and the seasonal rate of work is the time lost due to delays, and the difference in these rates of work indicates that the causes of delays to the harvester merit further study.

All delays and their cause were recorded during the detailed field observation, and were classified as follows:

1. mechanical breakdown,
2. waiting for transport,
3. clearing machine blockages and other minor delays.

Mechanical Reliability

Any group with less than five machines has been excluded. The results in Table 8 show how reliable potato harvesters have become with breakdown times of only 2-3 per cent of harvesting time. There is some indication that the machines with more complex mechanisms were slightly more prone to breakdowns.

Transport Delays

Analysis of the delays shows how inadequate transport can seriously limit the output of a potentially high capacity harvester. A feature of the figures in Table 8 is the high proportion of time wasted by the un-manned harvesters.

Machine Blockages

Elevators blocked by haulm and weeds were the most common cause of delay. On the manned machines overloading at the picking table caused delays, but the pickers tended to warn the driver to go more slowly in preference to a complete blockage.

Crop Losses

Earlier *PMB* surveys* indicated field losses of over 0·5 t. There was some evidence to suggest that losses in fields where complete harvesters were used were less than in fields lifted by spinners or elevator diggers, and subsequently picked by hand. Nevertheless, a loss of this magnitude in a high value crop was serious, and in the present study losses were checked on every farm where machine performance was measured.

* *1963 and 1968 PMB Maincrop Survey*

Table 8 **Machine Delays as per centage of Harvesting Time**

		Machine Type		Group	Number	Breakdown	Transport	Blockages and others	Total
MANNED	ONE ROW	Trailed	Medium priced	1A	29	1·8	2·4	5·1	9·3
			More expensive	1B	96	2·8	3·7	6·6	13·2
		Self-propelled		2	7	0	0·3	8·0	8·3
	TWO ROW	Trailed		3	15	0·2	6·8	9·0	16·0
UNMANNED	TWO ROW			6	25	5·9	15·1	12·7	33·7
	ELECTRONIC			8	9	9·4	4·1	8·7	22·2

Table 9 **The Weight and Value of Ware over 3·81 cm (1½ in) Riddle Size Left in the Field**

		Machine Type		Group	Leavings kg/ha (cwt/acre)	Average Yield t/ha (t/acre)	Percentage loss	Value £/ha (£/acre†)
MANNED	ONE ROW	Trailed	Medium priced	1A	2095·5 (16·5)	40·2 (16·1)	5·1	34·20 (13·7)
			More expensive	1B	1729·9 (13·6)	48·5 (19·4)	3·5	28·20 (11·3)
		Self-propelled		2	3822·7 (30·1)	40·7 (16·3)	9·2	52·20 (24·9)
	TWO ROW	Trailed		3	2819·4 (22·2)	40·5 (16·5)	6·9	46·00 (18·4)
UNMANNED	TWO ROW			6	1422·4 (11·2)	45·0 (18·0)	3·1	23·20 (9·3)
	ELECTRONIC			8	2501·9 (19·7)	41·5 (16·6)	5·9	40·70 (16·3)

†*Guaranteed price £16·55/ton*

Method

Five random samples were taken immediately behind the harvester. The area, which was dug by hand, was 91 cm (3 ft) by three times the effective harvester width.

Results

These results confirm that crop losses represent a serious loss of revenue and figures for each group of machines are given in Table 9.

Crop Damage

PMB Damage Classification

At the National Potato Harvester demonstration, the *PMB* measure and classify the damage caused by the lifting operation. The damage classification is as follows:

- A Undamaged
- B Surface scuffed, skin only damaged
- C Peeler damage, removed by 1·5 mm slice
- D Severe damage. Flesh wounds more severe than above

Average levels of severe damage recorded by all the complete harvesters at the last three demonstrations are shown in Table 10.

Table 10 Percentage of Severe Damage at PMB Demonstration 1963-70

Year	*Site*	*Soil condition*	*Percentage of severe damage*
1963	Huntingdon	Heavy loam over clay subsoil—dry	7·54
1964	Ripon	Light stony land in good condition	13·75
1970	Lincoln	Limestone soil with large quantities of stone	16·04

1971 Results

Due to limited resources and problems of staining damaged potatoes in the field, it was decided to limit the assessment to severe damage detected by visual examination of the un-washed potatoes. Five samples of 6·75-9·00 kg (15-20 lb) were taken from the discharge elevator which confined the damaged assessment to that caused by the machine. No attempt was made to measure damage to the potatoes when falling into or discharging from the trailers. Severely damaged potatoes are unsaleable and their value can be charged as a harvesting cost. Levels of damage in this study were considerably less than those recorded at any of the *PMB* National Demonstrations. At these demonstrations samples are taken from the trailer and are washed and stained. Transfer to the trailer can cause considerable damage and may account for some of the difference. The cost of even 3 or 4 per cent of severe damage, however, is considerable as shown in Table 11.

Causes of Crop Damage

An attempt was made to locate the causes of serious damage. In most cases a clean slice indicated that the share and side discs were the most common cause of damage. Relatively few cases of severe damage were caused within the separating mechanism of the machines.

Dirt Tare

The samples from the discharge elevator were used to assess dirt tares in addition to tuber damage. Most of the farms were visited during a prolonged dry spell and dirt tares were generally very low as shown in Table 12.

The elevator digger type of unmanned harvesters had the highest dirt tares, and on some farms the crop was graded into store. This operation is likely to increase damage levels and should be borne in mind when making comparisons between manned

Table 11 The Weight and Value of Damaged Potatoes

		Machine Type		*Group*	*Percentage severe damage*	*Average yield*	*Crop loss kg/ha (cw/acre)*	*Crop value £/ha (£/acre†)*
MANNED	*ONE ROW*	*Trailed*	*Medium priced*	1*A*	3·2	16·1	1308·1 (10·3)	21·2 (8·5)
MANNED	*ONE ROW*	*Trailed*	*More expensive*	1*B*	3·8	19·4	1866·9 (14·7)	30·5 (12·2)
MANNED	*ONE ROW*	*Self-propelled*		2	1·9	16·3	775·0 (6·2)	12·7 (5·1)
MANNED	*TWO ROW*	*Trailed*		3	4·1	16·2	1662·5 (13·3)	27·5 (11·0)
UNMANNED	*TWO ROW*			6	4·4	18·0	1663·7 (13·1)	39·5 (15·8)
UNMANNED	*ELECTRONIC*			8	4·4	16·6	1854·2 (14·6)	30·2 (12·1)

†*Guaranteed price £16·55/ton*

Table 12 **Percentage Dirt Tare**

		Machine Type		Group	Percentage dirt tare
MANNED	ONE ROW	Trailed	Medium priced	1*A*	5·2
			More Expensive	1*B*	3·8
		Self-propelled		2	2·4
	TWO ROW	Trailed		3	4·8
UNMANNED	TWO ROW			6	21·4
	ELECTRONIC			8	10·9

and unmanned harvesting systems. The *NIAE* Scottish Station is making a separate study of the problem of transporting and separating unwanted stones and clods at the farmstead.

Machine Utilisation

Acres Harvested Per Machine

Rising costs and shortage of labour are forcing the small farmer out of potato growing and the potato crop will be produced by a diminishing number of increasingly mechanized growers in the future. In 1968 75 per cent of growers had less than 4 ha (10 acres) of potatoes, but they accounted for only 20 per cent of the total acreage. At the other extreme 3 per cent of the growers control 30 per cent of the acreage. These figures were published in 1970 by *HMSO* in *The Changing Structure of Agriculture* and full details are given in Table 13.

Table 13 Numbers and Sizes of Potato Enterprise 1968

Acreage grown ha	(acres)	Percentage of total: Number of growers	Area
0·08-3·9	(¼-9¾)	75·6	20·0
4·0-19·9	(10-49¾)	21·4	50·3
20·0-40·0	(50-99¾)	2·3	17·5
Over 40	(Over 100)	0·7	12·2

Four years have passed since this data was collected, but comparison with the figures in Table 1 and Table 3 reveals some interesting information. In spite of the trend towards complete harvesters, demonstrated by Table 1, 60-70 per cent of the crop is in units of less than 20 ha (50 acres). Table 3 shows that some complete harvesters which were all less than three years old, were used on remarkably small acreages. Single row trailed harvesters, groups 1*A* and 1*B*, are by far the most common type of machine, in this study they represented 74 per cent of the sample. Thirty per cent of these single row machines lifted less than 8 ha (20 acres). Over 50 per cent lifted less than 12 ha (30 acres) and less than 20 per cent lifted over 20 ha (50 acres).

The effect of seasonal utilisation on the overheads of a harvester are illustrated in Fig. 2 these figures consist of the capital charges, depreciation and interest, assuming that a machine costing £2,000 three years ago is now worth about £1,000, and that the price of the new model has risen to £2,500. Wear and tear would of course vary with soil type, but the general level of depreciation cost per ha (acre) is given to draw attention to the order of magnitude.

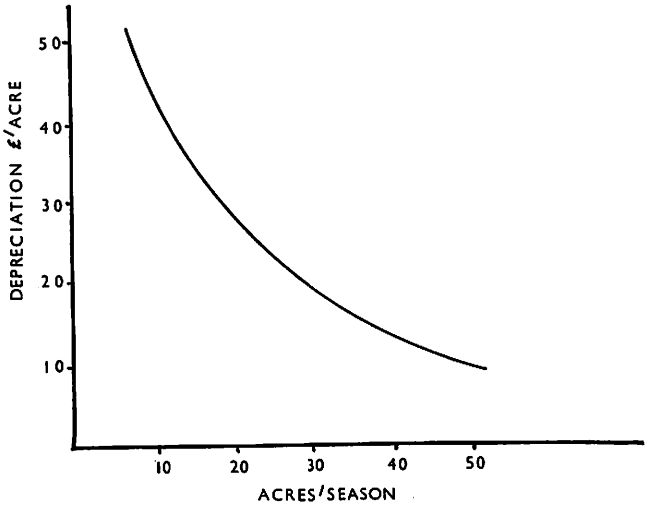

Fig. 2 The relationship between depreciation charges and acreage harvested per season.

These figures suggest that most potato growers changing their equipment regularly are faced with an overhead cost of at least (£20 acre) for the harvester alone. The two row machines covered more ha (acres), but overhead costs per ha (acre) were less reliable due to the wide variation of original cost and the small size of the sample.

Time Available for Root Harvesting

Table 4 showed that about one-third of all harvesters were used less than 100 h per season; 75 per cent of the single row machines were used for less than 150 h. A few of the two row machines were used for over 250 h, however, which suggests that most growers are unlikely to be limited by availability of suitable harvesting weather conditions. If 120 h is taken as a typical seasonal usage, and assuming six working h/d, 20 working days are needed. For the last three years, October contained over 20 working days in the main potato growing areas. In a difficult season, longer working hours on the good days would be necessary to avoid getting behind with the work schedule.

The generally poor standard of management of the transport operations from the two row machines suggested that very few farms had paid sufficient attention to this aspect of the harvesting system.

Machine Performance

Spot rate of work

The figure given in Table 5 for spot rate of work demonstrates that every type of machine is capable of a satisfactory spot rate of work. The variation from one farm to another for identical machines immediately points to the operator as the key factor in an efficient harvesting system.

The advantage of the 91 cm (36 in) row machines over narrower versions of the same model were much greater in terms of spot rate of work than might have been expected. Work at the *ADAS* Experimental Husbandry Farm at Terrington also reported increased speed with the wider rows. This was attributed to fewer clods in the wide rows which had not been cultivated so deeply, with the result that the sorters on the harvester had an easier task. The 1971 results add weight to the argument for wider rows and suggest a real financial advantage to offset the cost of alterations to, or replacement of, row crop equipment which are cited as the main obstacles to more general acceptance of the technique.

Net rate of work

The main point to emerge from the figures for net rate of work, which excludes breakdowns and delays, is that a field efficiency of about 75 per cent for a trailed harvester can be expected. The self-propelled single row machines were more efficient at 84 per cent and the unmanned two row elevator digger harvesters less efficient at 66 per cent. These last groups were rather small but the impresison gained was that provided the headland was wide enough, the self-propelled machines scored on quick turn-round.

Overall rate of work

The overall rate of work for the single row manned machines was about 0·10 ha (0·25 acre/h). With few machines averaging more than six working hours h/day, daily and seasonal potential is very low. This may not be critical to the large numbers of growers who harvest less than 8 ha (20 acres), but an overall rate of work only marginally better from the expensive self-propelled machines must cause concern to the growers with a large acreage. The electronic machines are clearly capable of a high rate of work as demonstrated by the figures for spot rate of work, but an overall rate of work no better than that of machines costing a quarter of the price severely limits the seasonal capacity, and even with shift working, overhead costs can become very unattractive unless seasonal utilisation is exceptionally good.

Delays to the harvesting system

Most farmers appeared satisfied with the mechanical reliability of the harvesters, and 2-3 per cent of lost time, due to breakdowns, appears reasonable. Some data was collected on the cost of repairs, but the enormous variation in the rates of wear of components on say a fen soil and a stony sandy soil, makes comparison between types of machine impossible. On some of the stony soils repair costs of over £5/0·4 ha (1 acre) were incurred.

Five-10 per cent of time was lost due to machine blockages in 1971 which was a dry season. More attention to haulm removal and weed control might perhaps ease this problem.

The most serious loss of harvesting time on many farms, and particularly on farms with potentially high output systems such as the unmanned 2-row elevator diggers, was due to inadequate transport systems. The organisation of the harvesting team in terms of transport requirements is predictable. In the cereal harvest, it is now generally accepted that the combine must not stop when the conditions are favourable. This is equally true of an expensive high performance potato harvester.

Closer supervision of the harvesting team could make a significant contribution to easing the autumn peak demand for men and machines.

Crop losses

The gross output from 0·4 ha (1 acre) of potatoes can be over five times that from 0·4 ha (1 acre) of barley, and one might expect farmers to go to great lengths to exploit the full potential of the potato crop. As far as crop losses are concerned the reverse appears to be the case. Loss of grain from combines has received wide publicity, and many farmers show concern when threshing losses exceed 1,250 kg/ha (0·5 cwt/acre) which represents only 1-2 per cent of the crop yield. The 1971 potato harvester study has revealed losses of over 5 per cent in the majority of cases, and the value of these losses is over £25/ha (£10/acre). In view of the lack of concern about losses in the potato field it is probable that very few farmers are aware of their magnitude, and even fewer have tried to measure and evaluate the cost of these losses.

Crop damage

The levels of severe damage reported in this study are low by comparison with *PMB* figures. Three-four percentage may not sound too bad, but is a loss to the farmer since the tubers are unsaleable. When translated into money, a 4 per cent loss in a 15 t crop represents over £25/ha (£10/acre).

Dirt tare

The complete harvesters were dealing very effectively with the crop as far as contamination with stones and clods was concerned. Sorting facilities at the store would appear to be an essential part of a successful system using unmanned harvesters. The transport system should be designed to cater for a minimum of 20 per cent stone and clod content.

SUGAR BEET AND POTATO PRODUCTION IN EUROPE

Edited Summaries of Discussions—Day 2

Discussion Papers 4 & 5

Mr Price (Ireland). I would like to make two comments on Mr I. Rutherford's paper. My comments are based on a survey of a similar nature to his own except that I went for the second alternative that he mentioned of going for a small number of harvesters in more detail. My first comment is on the one factor which I think wouldn't arise out of his sort of survey, which I think has a very big effect on what he calls his spot rate of work and which is in the control of the farmer, that is the spacing between the links of the digger web. Changes of 3 or 4 mm (0·12 or 0·16 in) in this spacing can have a tremendous effect on the amount of picking that the sorters have to do, and need not necessarily increase the losses significantly. Careful choice of this spacing I think can have quite a dramatic effect on the spot rate of work. The second point I wanted to make is in relation to losses. One certainly agrees that they should be kept to a minimum and one doesn't like to see losses of the size of which Mr Rutherford has recorded, but my few attempts to reduce the losses weren't very successful. Potatoes falling out of the ridge before they get into the harvester obviously is a problem which it should be possible to control. The other places where losses occur, either through webs or over the back with the haulm or being left in the ground are more difficult. When one tries to reduce these losses one either increases the amount of clods and stones that are coming up for the pickers or increases the damage to the potatoes by increasing the severity of the haulm remover and so you may increase the losses. Finally a question. There is a reference in your paper to work at *NIAE* Scottish Station on the problem of transporting and separating unwanted stones and clods at the farmstead. I wonder if either yourself or Mr D. McRae could enlarge on that a little bit.

Mr I. Rutherford. We took the link spacing as it was on the machine as most farmers do. Although there is an optional link spacing I do not think many farmers have alternative sizes of webs. Perhaps the most worrying aspect of the losses on a purely observational basis was the loss at the share. The losses between the links did not appear to be very high. On the question of the Scottish Station study, what happened was that when we found a farmer grading direct into a store from an un-manned harvester we asked the Scottish Station to look at it and Mr McRae can perhaps tell you about it.

Mr D. McRae. The information is available in a Scottish Station note, *A Survey of Un-manned Potato Harvesters.* One of the pieces of information emerging from this was that if the percentage of potatoes coming into the trailer was under 85 then it became very uneconomical for the farmer to take them to the store, remove the stones and clods and then transport these back to the field. But this was practice rather than necessarily hard economics.

Mr G. C. Mouat (Essex). I am interested in this problem of losses and it occurs to me that the problem may arise due to the fact that the majority of harvesters are designed for 72 cm (28 in) row or 80 cm (30 in) rows and they are now being called upon to handle a 90 cm (36 in) row.

Mr I. Rutherford. Most 90 cm (36 in) row machines are merely adapted from a 72 cm (28 in) row type and certainly if there is going to be more potato acreage in 90 cm (36 in) rows then we ought certainly to be demanding more attention to be paid to the intake end to take into account the different pattern of the potatoes within the row.

Mr J. H. Proctor. I would like to ask the panel about any experience they have had or of work they are thinking of trying to do on bulk handling of chitted seed potatoes, I particularly like the idea that we saw from Holland.

Mr F. E. Shotton. We have looked at sprouting in a heap in a barn and handling out of that heap with a 1·83 m (6 ft) wide mechanical shovel. This has been done very much on an experimental basis. The idea of using a big shovel is that although it will do considerable damage to a few potatoes it should only be a few potatoes.

Prof P. C. J. Payne (Chairman). Mr Rutherford, would you like to mention some of the definitions of work rate you have in mind and give your definition and challenge our continental friends? I would have thought that this is an opportunity that is very rare with continental and British agricultural engineers in one room.

Mr I. Rutherford. We have set out our definitions in the report from which my paper is drawn. What we did in this study was to start the watch as we arrived in the field, and check how many rows they had lifted; at the end of the day we counted the rows lifted and recorded the time and from that calculated a rate of work. It will include the machine breaking down, the operator having a smoke, the turns at the headlands, waiting for a trailer, in this country we call that the overall rate of work, but that only refers to the period that we were in the field. If that is the overall rate of work, what is the rate of work when the operator does one field and moves to another field and yet another field working for a whole week? That gives another rate of work. When trying to plan a system for a farmer, the rate of work in one field isn't really enough, you want to know the rate of work over the whole season. In this study we had records of how many acres the man harvested each day and how many hours he was lifting each day and if he had a major breakdown of more than half an hour he made a note of that, so you could say this is a seasonal rate of work. Coming back into one field again you can measure him from one point to another and that we called the spot rate of work. We ought to try and get some standardisation so that when we write a report and say net rate of work you in Holland can read it and know what we mean without having to explain it every time.

Mr F. Coolman. There has been an agreement in *CIOSTA* an international group of work study scientists, and as Mr Rutherford mentioned already, they have distinguished the different elements from the total output in a field for instance turning times, breakdown times, maintenance times, rest times for the personnel, times bound up to the total organisation, in this case digging, harvesting and transport. This is on the field itself. The next step is the organisation of the total job. This means not only what you call spot time but also the time necessary for carting off, changing trailers and many other things. These elements are symbolised with special signs originally based on a latin description, then you have the total output during a season. You cannot determine that with the aid of the normal stop watch method. There you need special data from the farmers or the drivers of the tractor and then you get a view into the organisation losses which can be large, I will mention to you one figure I have in mind at this moment. In Holland about 60 per cent of the potatoes are harvested by contractors due to the small size of the farm. The contractors lose about 40 per cent of the total time they could harvest during the season. I think your proposal, Mr Rutherford, to have more contact in this field is very important and I think contact between the specialists dealing with these jobs in the coming months should be made, so that we can try to put it on the agenda of *CIOSTA* meeting. They have a special working group on this subject. This would give more international understanding of figures. If you agree I will contact them, the secretary is one of the members of our Institute, and I think in that way we will come to a better understanding.

Mr J. A. Fellowes (Cambridgeshire). I would like to take up a point that Mr Mouat made earlier on regarding machine design and damage. I am quite convinced in my own mind that the greatest single factor is operator damage ie bad setting of machines which could be cured by education of the operators. You brought up a point regarding travelling speed in the field with a machine racing along and then having to wait for trailers. We had quite an interesting experience this last year with this because we were doing damage tests on all potatoes going into the store, and in the particular case the field was a very long way away so the driver dropped down a gear, and the damage, and this is just superficial damage not bruising underneath which comes out later, went up from 12 per cent to 29 per cent. The best thing he could have done was to keep going and wait at the end and light up a cigarette. What I would like to ask is if any work is planned on bruising, because what you have mentioned has really covered just very obvious damage on the outside. Some of this bruising we can't see until 48 hours later and then it's too late to do anything about it.

Mr I. Rutherford. We have tried to look at bruising and the problems of trying to measure it we find very very difficult, and as an advisory service, or at least a small part of an advisory service, we've backed out of it and we feel that this is perhaps a job best left to our experimental farms where they've got better facilities and more things under their control.

Mr F. E. Shotton. I agree with what Mr Fellowes has said about the rate of work. To study bruising quite a lot of apparatus is required and you have got to destroy quite a lot of potatoes. It is quite a costly business to go looking for bruising. We are setting out to try and do this. We are aiming to be able to run our harvester web at different speeds with a variable speed device, but we are very clearly behind the Netherlands in this respect and they have more information, perhaps more in connection with store management than harvester management.

Mr F. Coolman. A potato will not be damaged as long as it is packed in soil and that's the reason that if forward speed is slower for the same speed of the machine parts, the soil is going out faster and there is less soil for protection so damage is greater. What we try to tell the farmers is that they must find a forward speed, a machine speed, elevator speed and so on, that the potato is packed in a little soil till the end of the first chain, afterwards it's only transporting and no more damage is done. We have done research on this and picked samples out of several parts of the machines and several machine types. Finally, how were the machines selected for the Survey?

Mr I. Rutherford. Every other year the Potato Marketing Board carry out a survey of 2,000 of their growers and their computer prints out a list of growers at random. With the help of the Potato Marketing Board we went through these and first of all discarded all the ones without complete harvesters, then discarded all the ones that didn't have new potato harvesters. By this time we had about 250 and then we went to these farms, in some cases they were not suitable because the farmer had two harvesters in one field or something similar so we eventually got down to about 200 machines very much at random.

Mr F. Coolman. Was there a technical man who looked at the machine to see that it was in optimum condition, or did you record it just as it was in the field at that moment?

Mr I. Rutherford. We took the machine as the farmer was using it. You can do two things, either look at the machine and decide it is not being used properly and try to set it, then you are not really looking at what the farmers are doing, or you can go to the machine and even if something's wrong you can record it. We were trying to find out what was happening on the farms in 1971 and we thought the fairest thing to do was to go and see what was happening without trying to change it otherwise we could have been accused of "cooking the books".

Mr F. Coolman. Yes! It's very interesting but in that way it is not a survey of machines, it is a survey of machines and their operators, in combination.

Mr I. D. Geddye (Shropshire). First of all to Mr Rutherford, I sympathise and agree with the concern that he expresses over the question of losses and I think that this a very serious problem that needs serious consideration but at the same time although he is talking in terms of £25-£37.50/ha (£10-£15/acre) loss from the harvester and a similar sort of loss from damage he is talking of something like 5 per cent loss of the total crop. Would Mr Rutherford care to put some figure forward which is acceptable. In an ideal world one wants no losses and this is what we are all aiming for but at the same time I think a small degree of loss must be accepted. And to Mr McRae, you said that the cost of your device for sorting potatoes and clods is something like £800. You suggested that this expensive piece of kit could be hired for the season of three months. Can you give us some indication of what this would cost the farmer.

Mr I. Rutherford. What loss are we prepared to accept? Well this is something that we would like to ask the farmer, but before you can ask the farmer you have got to find out what loss he is getting already without perhaps knowing it. If we can draw on the experience of combine harvesters for instance, 25.49 kg (0.5 cwt) from a combine is about a 1 per cent loss. Now most farmers seem to be prepared to accept 1-2 per cent loss from a combine, should we accept any lower standard from potato harvesters, but my first query is, do farmers know that they are losing 5 per cent from potato harvesters?

Mr D. McRae. In reply to the point about the cost, the £800 I stated was the cost of the actual isotope bars, and as regards the hire charge it's very hard at this stage to estimate but something of the order of £120 to £150 per annum would seem reasonable. We are talking about part of the entire electronics device which if one takes a parallel cost with the existing system on the market is likely to be around £3,000 so that this £800 is a fraction of the whole but it is a very sizeable fraction which the farmer needn't be charged with at all, merely he would have a hire charge attached to it.

Mr I. Rutherford. I notice the gamma ray machine is using an hydraulic activator on the fingers, the earlier machine had pneumatic actuators. I understood that hydraulics were too slow. Have they improved significantly or is it cheaper?

Mr D. McRae. We settled for hydraulics because first of all the facility of using the tractor hydraulics was an appealing one and because of the presentation method we can scan at the rate of about four and five objects/second/channel and at this speed the ordinary hydraulic action is fast enough. The little round cylinders are very small so that this means with a reasonable oil flow the operation is quite fast, and in fact we found that the initial action was so fast that normal metals disintegrated and for instance aluminium which was a desirably light metal to use just simply couldn't be used and we have now settled for a stainless steel which is much better.

Mr F. Coolman. Mr Rutherford has put another question on the table. Shall we analyse a small number of machines quite deeply or shall we make a survey. I will try to give him my impression on this point. In the first place it depends on what you want to know. If you want to have figures about, in this case, potato harvesting as a job then I think the methods you are following now are giving you a satisfactory indication and information, but when you pose the question how are these machines performing, then you have to approach it from another angle. May I give you a short description of the testing procedure we are following in our country?

Let us say in 1973 we are starting a test of potato harvesters. As an example, we will invite all the deliverers of the machines present in our country to take part in a group test and during this group test there are say five or six deliverers sending their two row machines, together with the technicians of the deliverers we try to set those machines as well as possible in the different circumstances and then our own drivers drive these machines. Sometimes we are using their tractors or the same tractor for all the machines, if a constant and an equal speed is needed. So we try to give all the machines the best opportunity to do their job. We are making observations and at the end a report is made and together with the deliverer it is decided whether it will be published or not. Apart from the group test we are making enquiries of about 20 users of each machine in the form of a questionnaire after the season. These two contributions to the report we feel are enough to get good information on the machine itself. The group test is not a competition. From the group tests individual bulletins are produced and the relationship with the industry is such that as soon as a bulletin is ready it is sent to the deliverer of the

→ *foot page 57*

The Commission Internationale du Genie Rural

DETAILS of the objectives and organisation of *CIGR* were published in Vol. 25 No. 4 of the *Journal* in an article entitled *CIGR and the Institution* written by C. Culpin *OBE MA FIAgrE.*

The Commission is divided into five sections:—

Section 1 Soil and Water Engineering.
Section 2 Farm Buildings and Associated Engineering Problems.
Section 3 Power and Machinery.
Section 4 Application of Electricity to Agriculture.
Section 5 Scientific Organisation of Agricultural Work.

The Institution of Agricultural Engineers is the official representative of *CIGR* in the *UK* and has appointed correspondents for each of the Sections as follows:—

Section 1 J. Waterhouse *BSc (Eng.) Hons (London) C Eng FICE FIWE*
National College of Agricultural Engineering, Silsoe, Bedford.

Section 2 S. Baxter, *ARICS*,
The Scottish Farm Buildings Investigation Unit,
Craibstone,
Bucksburn,
Aberdeen AB2 9TQ.

Section 3 J. H. Neville *BSc MSc MIAgrE*,
National College of Agricultural Engineering, Silsoe, Bedford.

Section 4 R. A. Bayetto, Agricultural Adviser,
The Electricity Council,
30 Mill Bank,
London SW1P 4RD.

Section 5 N. W. Dilke
NDA CDA MInsWS AMIAgrE
Seale Hayne Agricultural College,
Newton Abbott,
Devon.

Members requiring further information concerning activities of Sections are advised to contact the appropriate correspondent. Some details of future events and proceedings are given below.

Future Events

Section III Study Days. WARSAW, 17-22 September, 1973. Subject: Development Prospects of Agricultural Tractors. *Enquiries: to Mr Dr Ing. A. SOLTYNSKI, Institut de Mechanisation et d'Electrification Agricoles, ul. Rakowiecka 32, WARSZWA (Poland).*

Section II Study Days. HELSINKI, June 1973. Farm Buildings Seminar.

International Conference on Agricultural Engineering and Environment. AACHEN (Federal Republic of Germany) 6-7 September, 1973. *D. P. Evans (ADAS, Silsoe) giving paper for Section III.*

Conference on the techniques of reclamation on sandy soils. BRATISLAVA. 4-9 June, 1973. *Enquiries: to Sekretariat Slovenskej vedeckotechnickej soplocnosti poinohospodarskej a lesnickej, Stefanikova 39, BRATISLAVA (Czecho-Slovakia).*

8th International Congress of Agricultural Engineering. FLEVOHOF, Netherlands. 23-29 September, 1974. *Bulletins to be published by CIGR Secretariat.*

9th International Congress on Irrigation and Drainage—*ICID/CIGR, MOSCOW,* May/June.

Recent Events

Section I Study Days. FIRENZE. 12-16 September, 1972. Subjects—a. Surface irrigation and sub-irrigation: technical and economical problems of installation and use. b. Soil erosion and conservation: scientific bases and technical applications, experiences and realisations. *Proceedings to be published by CIGR.*

Section I International Survey on the scientific basis of soil draining, drainage methods and their efficiency. *Final report now published.*

Section III Study Days—SILSOE 2-4 October, 1972. Subjects: Mechanisation of Sugar Beet and Potatoes. *Proceedings published in* The AGRICULTURAL ENGINEER *(this issue).*

Section V Colloquium. BAD-KREUZNACH. November, 1971. Subject: Heart rate recording and its application to work study in Agriculture. *Proceedings to be published by CIGR.*

PRESIDENTIAL SPEECH

As the annual dinner of the Institution has been replaced by a luncheon, time prevents the President from delivering his speech. It has been written and to ensure members do not miss it is enclosed as an insert in this issue of the AGRICULTURAL ENGINEER.

concluded from page 56

machine and then he is free to say if he will have it published or not. If not then he can make free use of the data he has already got from the talks and the test, he can improve his machine and he can come back with these improvements and then perhaps the bulletin will be issued. The main thing in my opinion is to define the problem. Do you want information about potato harvesting or do you want information about the machine? The problem is that these two questions are not the same.

Mr I. Rutherford. Thank you very much Mr Coolman, I see the difference. We come into the former category, we are looking at potato harvesting rather than the actual machines themselves. You are indeed fortunate in living in a country where there are facilities to do a serious test on machines.

ADMISSIONS

AT a meeting of the Council of the Institution on 19 October 1972 the following candidates were admitted to the Institution or transferred from one grade to another.

FELLOW

Newman, G.	*Suffolk*

MEMBER

Dexter, A. R.	*Bedfordshire*
Morley, E. G.	*Gloucestershire*
Takeda, S.	*Japan*

GENERAL ASSOCIATE

Amedzor, S. K. K.	*West Africa*
Hansom, G. S.	*Yorkshire*
Heath, M. H.	*Hertfordshire*
Lock, R. J.	*Essex*
Lucas, T. B.	*Staffordshire*
McNamara, W. E.	*Suffolk*
Okeji, D. D.	*Nigeria*
Rand, G. E. A.	*Devonshire*
Waldron, R. F.	*Yorkshire*

TECHNICIAN ASSOCIATE

Clark, J. T.	*Essex*
Gibson, K. L.	*Lincolnshire*
Hallam, K. E.	*Warwickshire*

GRADUATE

Borobia Clemente, E.	*Venezuela*
Cartmel, S. D.	*Staffordshire*
Couchman, M. G. E.	*Surrey*
Cox, A. L.	*Bedfordshire*
De Silva, G. S. C.	*London*
Douglas, M. P.	*Bedfordshire*
Hossne Garcia, A. J.	*Northumberland*
Jones, A. R.	*Worcestershire*
Mutelo, J. B.	*Zambia*
Rothery, C. C.	*Essex*
Samson, C. B.	*Fife*
Shafi, M.	*West Pakistan*
Suleiman, S. M. A.	*Saudi Arabia*

STUDENT

Vella, S. A.	*Malta*

TRANSFERS

MEMBER

Bebb, D. L.	*Essex*
Bernard, M. P.	*Rhodesia*
Bibby, F. R.	*Iran*
Bostock, P. B.	*Middlesex*
Chaudhary, F. M.	*Pakistan*
Hutton, G. J.	*Australia*
Laing, A. S.	*Yorkshire*
Provan, I. H.	*Aberdeenshire*
Sea, P. G.	*Canada*
Sheppard, D. R.	*Lancashire*
Smith, R. H.	*Wiltshire*
Turner, P. T. D.	*Oxfordshire*
Wainwright, R. P.	*South Africa*
White, G. C.	*Monmouthshire*

TECHNICIAN ASSOCIATE

Free, A. V.	*Eire*
Riddell, D. G. B.	*Ayr*
Velauthapillai, P.	*Ceylon*
Walton, D. J.	*Yorkshire*
Wilding, K. H.	*Northumberland*

GRADUATE

Archer, P. G.	*Lancashire*
Back, H. L.	*Essex*
Bin Sukra, A.	*Malaysia*
Cooke, J. S.	*Lincolnshire*
Grainger, M. F.	*East Africa*
Idah, G. O.	*Nigeria*
Mahdi, I. K.	*London*
Morrison, R. R.	*Northumberland*
Platt, G. D.	*Lancashire*
Pollard, R. W.	*Cambridgeshire*
Taylor, M. J.	*Middlesex*
Tilley, M. L.	*Devonshire*
Tullett, K. N.	*Sussex*

ANNUAL CONFERENCE

Waste Treatment and Disposal

THE annual conference of the Institution being held on 8 May will deal with *Farm Waste Treatment and Disposal.* There will be papers and associated discussions on solid/liquid separation of wastes, the design and operation of farm treatment plants, modern systems for the disposal of wastes on land, and the design and planning of buildings and fixed equipment for efficient waste handling and disposal.

Further details appear on page 63.

AROUND THE BRANCHES

South Eastern

'PIGS need straw' was the central theme of the third of a series of autumn meetings held at Writtle Agricultural College. Mr Mike Metianu, livestock environmental specialist, *ADAS*, Cambridge was the principal speaker and Mr Ernie Barker, the local *ADAS* drainage advisor acted as chairman.

Mr Metianu opened his talk by examining the complex relationships between the many factors which need to be considered by the pigman including genetics, environment, nutrition and management. A wealth of statistical data was presented to re-inforce his view that straw is a valuable aid to pig production. Several slides were shown to demonstrate good and bad practice in commercial pig production.

The closing contribution to the discussion was made by Mr Dave Baker, lecturer in pig husbandry at the college. He made special reference to Mr Metianu's ability to translate specialist research data into recommendations for commercial practice.

West Midlands

MORE than 40 people attended the West Midlands Branch meeting in September to hear Mr W. J. Muddle, chief plant and transport manager of the Forestry Commission, speak on *Machinery in the Forestry Industry.* The chairman was Mr Cecil Cowley (chairman of the West Midlands Branch).

Mr Muddle said that timber was the second largest import into the *UK* and the money earned from the export of all Britain's car output was not sufficient to pay for it. Thirty seven million cubic metres were imported annually at a cost of £713m. Home production of timber was very small by comparison, amounting to 3·2 million cubic metres.

Forestry, he continued, was a long term matter and showed no quick profits owing to the high costs and difficulty of clearing and planting inaccessible swamp or mountainous areas, and the Commission had always been heavily subsidised by the tax payer. However, it was hoped in the next five years to go a long way to breaking even financially.

During the showing of films of the Commission's operations and machines, Mr Muddle explained that his greatest difficulty was that no British manufacturer made tractors or machinery for the forestry industry specifically, so the Forestry Commission were forced to produce hand built machines in their own workshops at very high cost, adapt existing agricultural machines, or import specialist machines,

mainly from Finland and Scandinavia, which were not always successful in Britain.

Opening the discussion which followed, Mr B. A. F. Hervey-Bathurst said he regretted the preponderence of foreign forestry machinery, particularly chainsaws and post hole diggers, due to the scarcity of British makes available. In his own private woodlands he had no specialist tractors for the work as they were too costly. He operated, he said, quite successfully with adapted, but otherwise standard, agricultural tractors.

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THE annual forum of the West Midlands Branch of the Institution was held at the Farm Electric Centre, Stoneleigh, on 30 October, when the main speaker was Mr Neil Marten *MP*, Conservative *MP* for Banbury. Other speakers were Mr Jonathan Harrison, managing director of Howard Rotavator Co. Ltd, Mr J. W. Roberts, market research manager of David Brown Tractors Ltd, Mr T. B. Boden, a Staffordshire farmer, representing the National Farmers Union. Mr John Alcock, sales director of Bomford & Evershed Ltd, opened the discussion from the floor. The title of the meeting was *Europe as Seen Through the Eyes of a Politician, a Tractor Manufacturer, an Agricultural Machinery Manufacturer, and a Farmer.*

Mr Marten, an ardent anti-marketeer, started by saying, "we could have had a free trade area which would have generated more trade than the Common Market if we had decided not to go into Europe. Britain's expansion of trade should be with the whole world including the Commonwealth."

Mr Jonathan Harrison said that the *UK*'s output of 140,000 tractors a year already equalled the combined output of Italy and France and exceeded Germany's 100,000. He pointed out that Britain had a large number of small companies in the agricultural machinery industry, but he was confident that we could be competitive. We had to find out exactly what the Common Market farmer wanted and then supply it.

Mr J. W. Roberts said, "We British tractor manufacturers are heavily reliant on exports. Seventy per cent of our output is exported. One hundred and ninety thousand tractor sales occur annually in the countries of the Community and we are at present virtually excluded by their 18 per cent tariff barrier. Before the Community was formed our exports to the countries comprising it ran at around 13,000 tractors a year. Since then it had dropped to 2,700. I welcome entry by Britain and am convinced that as a member of the Community our exports to the rest of the world will not be adversely affected."

Mr Tom Boden said, "The farm machinery industry should never forget that without the farmer it would not exist, and the 30 per cent output which went into the home market was important to them. The British farmer will continue to buy British machinery if he is not let down on quality, spares and service, but the machinery trade should make him feel that he is wanted and should realise that he often works a seven day week, and service and spares should be available on that basis. Farmers in the main are poor mechanics and hard on machines, which should be as sturdy and simple as possible. Much trouble is caused by lack of standardisation, even in simple things like bolts, chains and belts."

Mr John Alcock, opening the discussion, said, "As the sales director of an expanding local company already trading into Europe I see distinct advantages for British agricultural machinery manufacturers in entry to the Common Market. There we find 180 million people compared with 50 odd million people in the *UK*."

●

THE West Midlands Branch have commissioned the School of Art of the Mid-Warwickshire College of Further Education, Leamington Spa, to design and execute a trophy to be awarded annually to a non-corporate member of the Branch (Associate, Graduate or Student member), and to be known as the *West Midlands Branch Technical Award*. It will have the object of encouraging interest, initiative and original thought and will be for an original machine or implement or mechanism design in the form of drawings, sketches, models or proto-types; or modifications to existing machinery, equipment or service tools; or original written work, such as a thesis, survey, report or appraisal. The award will be presented for the first time at the West Midlands Branch annual dinner on 13 April 1973.

FORTHCOMING EVENTS

March

4-11	*SIMA*, Paris.
4-11	*CIGR* 18th Session of Management Committee meeting, International Farm Machinery Show, Paris.
5	*IAgrE* South East Midlands Branch meeting. *Herbicides and the Agricultural Engineer,* at the National College of Agricultural Engineering, Silsoe, Bedford, 19 00 hr.
5	*IAgrE* West Midlands Branch meeting. *Problems of Mechanisation in Developing Countries,* at the Farm-Electric Centre, *NAC*, Stoneleigh, 19 30 h.
7	*IAgrE* South Eastern Branch meeting. *Developments in Combine Harvester Design and Utilisation,* at the Essex Institute of Agriculture, Writtle, 19 30 h.
8	*IAgrE* South Western Branch meeting. *Mechanised Livestock Feeding,* at The Plume of Feathers Hotel, Okehampton, 19 30 h.
12	*IAgrE* Wrekin Sub-Branch annual general meeting, 19 00 h. To be followed by *Engineering Aspects of Rotary Parlours,* 20 00 h. To be held at the New Lecture Block, Harper Adams College, Edgemond, Newport, Salop.
13	*IAgrE* Northern Branch meeting. *Energy Resources in the Future: What Happens When the Oil Runs Out?* at the University of Newcastle-upon-Tyne (Agriculture Department), 19 15 h.
14	*IAgrE* Western Branch meeting. *Maize Growing in UK,* at the Bath Arms, Warminster, 19 45 h.
15	*IAgrE* Yorkshire Branch annual general meeting, followed by *Steering Layouts of Large Agricultural Tractors,* at Griffin Hotel, Boar Lane, Leeds 1, 19 30 h.
15	*IAgrE* Yorkshire Branch meeting. *Articulated and Conventional Steering,* at the Griffin Hotel, Leeds.
22	*IAgrE* North Western Branch annual general meeting. Dinner: 18 30 h, meeting: 20 00 h, at The Royal Oak Hotel, Chorley, Lancs.
23	*IAgrE* East Anglian Branch annual general meeting, followed by*The Fisheries Laboratory, Lowestoft,* at Scole Inn, Diss, 19 30 h.
27	*IAgrE* Northern Branch annual general meeting, at the University of Newcastle-upon-Tyne (Agriculture Department), 19 15 h.

April

6-15	*FIMA/73,* Zaragoza, Spain.
8-13	1st International Green Crop Drying Congress, at Oxford University.
10	*IAgrE* Yorkshire Branch meeting. *The Effect of Regulations on a Tractor Braking System,* at University of Leeds, Department of Mechanical Engineering, 19 30 h.
12-14	5th International Agricultural Mechanisation Conference, *Irrigation and Drainage—New Mechanical Technologies,* at *FIMA/73*.
13	*IAgrE* West Midlands Branch annual dinner.
19	*IAgrE* East Midlands Branch annual general meeting and dinner.

May

8	*IAgrE* Annual General Meeting and Annual Conference on *Farm Waste Treatment and Disposal.*
24	*IAgrE* North Western Branch visit to Manchester Corporation Watch Gate Water Treatment Plant, Kendal.

June

24-30	*CIGR* Section II Study Days—Farm Buildings Seminar, Helsinki, Finland.

OBITUARY

Sir Alexander Glen

SIR ALEXANDER GLEN KBE CB MC, Secretary of the Department of Agriculture for Scotland from 1953 until his retirement in 1958, died in hospital on 16 December 1972 aged 79 years. He spent 38 years in the Civil Service, serving in the Treasury from 1920-1935 before transferring to the Department of Agriculture, where he became an assistant secretary in 1939 and deputy secretary in 1945. In 1960, the Secretary of State for Scotland appointed Sir Alexander to be one of his representatives on the Scottish Milk Marketing Board for a period of three years. He was made an Honorary Fellow of the Institution of Agricultural Engineers in 1959 for services rendered.

K. A. Taylor

MR KEN TAYLOR, in charge of lubricants and special products for the agricultural market of Shell-Mex and *BP* Ltd, and a member of the Council of the Institution of Agricultural Engineers and chairman of the Finance and General Purposes Committee, died in hospital on 24 November, after a short illness. Aged 46, he had been a member of the Institution for four years.

Educated at Royds Hall Grammar School, Mr Taylor later went to Coventry Technical College where he gained a Higher National Certificate in automobile engineering. He subsequently served his apprenticeship in Coventry with Daimler Co. Ltd, then continued as a design draughtsman, where he stayed a year before joining Shell International Petroleum in Maracabio, Venezuela with Shell International Company's Experimentation and Production Unit, where he was in charge of drilling plant maintenance. He returned to England in 1961.

Ken Taylor was a much respected professional engineer, he set himself extremely high standards, an example to friends and colleagues alike.

He is survived by his wife and two young children.

Reprint Service

It is possible to obtain copies of lectures and articles appearing in the Institution Journal, or other publications

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THE INSTITUTION OF AGRICULTURAL ENGINEERS
EDITORIAL UNIT, PENN PLACE,
RICKMANSWORTH, HERTS.

PUBLICATIONS

Electrics 72/73

THE Electricity Council have published *Electrics 72/73* which they now intend publishing annually. The current issue, described as a handbook of electrical services in buildings, runs to 587 pp, and measures 5¾ in by 8¼ in.

Electrics 72/73, The Electricity Council, Marketing Department, Trafalgar Buildings, 1 Charing Cross, SW1A 2BR, price £1·25.

British Engines: The BICEMA Catalogue

THE 8th edition of the *BICEMA* (British Internal Combustion Engine Manufacturers' Association) catalogue of British combustion engines, gas turbines and associated components and equipment has now been published. It is A4 size and contains 200 pages.

Copies are obtainable from the publishers.

British Engines: The BICEMA Catalogue, price £4·00 sterling (or its equivalent), Whitehall Press Ltd, 29 Palace Street, Westminster, London SW1E 5HW.

SCHOLARSHIP AWARDS IN AGRICULTURAL ENGINEERING

Dunlop Scholarship

THROUGH the generosity of Dunlop Limited the Council of the Institution of Agricultural Engineers is able either:—

(a) to provide a grant of up to £750 to enable the Graduate Engineer or other person considered suitably qualified to reach for a higher degree by an examination at the National College of Agricultural Engineering or to conduct research for a period not normally exceeding one year; or

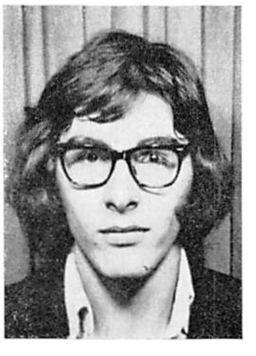
(b) to provide a grant of up to £250 to a candidate for the National Diploma in Agricultural Engineering who, without such financial assistance, would be unable to follow the course.

Applications should be sent to the Secretary, The Institution of Agricultural Engineers, Penn Place, Rickmansworth, Herts; not later than 1 August 1973.

Shell Mex and BP Bursaries

AS a result of interviewing eight candidates who had applied for and shown themselves eligible to be considered for an award of either the Dunlop Scholarship 1972 or a Shell-Mex and *BP* Bursary 1972, the panel unanimously resolved that the Dunlop Scholarship Award should not be awarded to any candidate this year, but that Shell-Mex and *BP* Bursaries of £50 be offered to Mr Nicholas Edward Ellis, Mr Normann Thelwell and Mr Martin Crawford Wright, to assist them to undergo full time tuition at a recognised training centre leading to examinations assessable for the award of the National Diploma in Agricultural Engineering.

Mr Ellis (20) of Sunningdale, Berks., did his initial schooling at Forest School in Essex. Later he joined the College of Aeronautical and Automobile Engineering and studied for



Mr N. E. Ellis

INSTITUTION OF AGRICULTURAL ENGINEERS

Annual General Meeting and Conference, 8 May, 1973

The Handling, Treatment and Disposal of Farm Wastes

This is an all-day Conference to be held at Institution of Mechanical Engineers and will cover the important engineering, building and management aspects of this subject. Four papers and associated discussion periods will deal with the disposal of wastes on land, the design and operation of farm treatment plants, the solid/liquid separation of slurry and the design and layout of buildings for efficient waste handling and disposal.

Programme

10 00	*AGM* of Institution of Agricultural Engineers.
11 00	Chairman's introduction to the Conference.
11 10	Application of farm slurries to Agricultural land. K. A. Pollock. University of Newcastle-upon-Tyne.
11 50	Principles of Operation and design of farm waste treatment plants. S. Bains. West of Scotland College of Agriculture. R. Q. Hepherd. National Institute of Agricultural Engineering.
12 15	Short Discussion of Morning paper.
12 30	Lunch.
14 15	Equipment and methods for the solid/liquid separation of slurry. R. Q. Hepherd. National Institute of Agricultural Engineering. J. C. Douglas. West of Scotland College of Agriculture.
14 50	Discussion.
15 00	Design and layout of buildings for efficient farm waste handling and disposal. C. Dobson *ADAS* (Lands Arm) Reading.
15 40	Discussion on all papers.
17 30	Close of Conference.

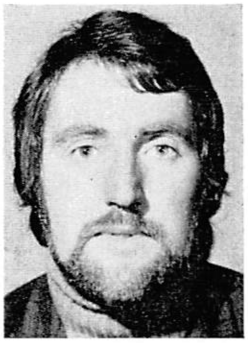
Timing of paper and discussions may be subject to alteration his City and Guilds 465 and 261 certificates, both of which he passed, the latter with a credit. He is now at the West of Scotland College of Agriculture studying for his National Diploma in Agricultural Engineering.

He says his interests are 'playing with engines', namely his car, working with and making things on machines, reading and listening to records. He is enthusiastic about football and skiing and hopes to be able to indulge more in these sports in the future.

When he is qualified Mr Ellis said he would like to go abroad to further his career in sales and management in agricultural engineering.

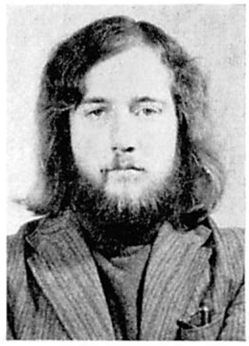
Mr Thelwell (25) of Mold, Flintshire, attended Ysgol Daniel Owen Secondary School in Flintshire, and subsequently the Flintshire Horticultural College, Northop, the Flint College of Technology, Lackham Agricultural College and Chippenham Further Education College, and has passed both his City and Guilds 260 and 261 certificates. He served as an apprentice in agricultural engineering between October 1963 and September 1969 and as a mechanisation technician at the Welsh Agricultural College from September 1971. He is sitting for the entrance examination to the West of Scotland Agricultural College where he hopes to study for his National Diploma in Agricultural Engineering.

In his off duty times Mr Thelwell is interested in painting in oil and water colour and has exhibited often, and during his time with the *ATC* he obtained his glider pilot's wings. He is a steam engine and old machinery enthusiast and has travelled frequently to rallies and shows, and is also interested in helping to renovate old farm implements.



Mr N. Thelwell

Mr Wright (23) of Preston, Lancs., attended Urmston Grammar School for Boys from 1960-1967 and followed this with technical education at the Lancs. College of Agriculture. He has gained practical experience in agriculture at a farm in Pewsey, Wilts., during which time he undertook a practical sandwich course at Lancs. College of Agriculture. He has been accepted by Essex Institute of Agriculture, Writtle, where he is studying for his post diploma *NDAgricE*.



Mr M. C. Wright

His family background is entirely non-agricultural, as his father is an architect.

INSTITUTION OF AGRICULTURAL ENGINEERS
Autumn Meeting 1973

Irrigation for Agriculture and Horticulture in the 70's

National College of Agricultural Engineering, Silsoe, Beds.
27 September 1973

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