A small plot potato planter

W.J. ARSENAULT, H.W. PLATT, E. PIPPY and A. CANNON

Agriculture and Agri-Food Canada, Research Centre, Charlottetown, Prince Edward Island, Canada C1A 7M8. Contribution No. 823. Received 24 October 1995; accepted 29 March 1996.

Arsenault, W.J., Platt, H.W., Pippy, E. and Cannon, A. 1996. A small plot potato planter. Can. Agric. Eng. 38:145-147. A two-row planter was constructed for planting small potato research plots. For each row, seed pieces were manually placed on a cup conveyor belt system. Desired in-row seed piece spacings, per row, were obtained by controlling the speed of the conveyor belts using variable speed gearboxes. Micro-dial controllers, attached to the gearboxes, allowed for rapid adjustment of in-row seed piece spacing when required. Small fertilizer hoppers, similar in design to commercial planters, were attached to the planter when a uniform type or rate of fertilizer was required at planting. When planting required different types or rates of fertilizer, hoppers were removed and replaced by two Hege (model H80) belt cones. Fertilizer required per treatment row was placed in the cone prior to planting then applied as cones rotated. The rotation of the cones was controlled by a variable speed gearbox with micro-dial control to adjust the row length of fertilizer application when required. The planter performed well compared to commercial and other small plot planters. The coefficient of variation for seed piece spacings ranged between 11 to 15% and labour required for planting was 40 to 60% less compared to hand planting.

Une planteuse à pommes de terre à deux rangs a été construite afin d'ensemencer de petites parcelles expérimentales. Pour chacun des rangs, les semences étaient placées manuellement sur un convoyeur à godets. On obtenait l'espacement des semences désiré sur le rang en contrôlant la vitesse du convoyeur grâce à une boîte de vitesses à vitesses variables. Un contrôleur à cadran permettait un ajustement rapide de l'espacement des semences sur le rang. De petits coffres à engrais, similaires à ceux des plantees commerciales, étaient attachés à la planteuse lorsque les taux de fertilisation et les types de fertilisants requis lors de l'ensemencement étaient semblables. Lorsque les taux de fertilisation et les types de fertilisants requis différaient, les coffres étaient remplacés par deux convoyeurs à cônes Hege (modèle H80). Pour chaque traitement, les fertilisants étaient placés dans les cônes, avant l'ensemencement, et appliqués à mesure que la rotation des cônes se faisait. La rotation des cônes étaient contrôlée par une boîte de vitesses à vitesses variables et un contrôleur à cadran qui permettait d'ajuster la longueur sur laquelle l'application se faisait. La planteuse a bien fonctionné si on compare aux plantees commerciales et aux autres plantees de petites parcelles. Le coefficient de variation de l'espacement entre les semences allait de 11 à 15 % alors que le temps requis pour effectuer le travail était réduit de 40 à 60 % par rapport à un ensemencement manuel.

DESCRIPTION

At potato research and extension centres, hand planting small field plots is often required, a labour intensive and costly operation. Commercial potato planters are generally unsuitable for research plot work requiring precise in-row seed spacing. Two-row commercial planters do not permit rapid in-row seed piece spacing adjustments or planting adjacent rows using different varieties, seed piece spacings, or fertilizer rates. The accuracy of in-row placement of seed pieces is affected by the mechanical design of a potato planter. Misener (1982) indicated that the coefficient of variation (COV) for seed placement of various commercial planters operating on farms could range from 48.2 to 86%; which is considered unacceptable for potato research plantings.

Commercial planters have been modified for planting research plots. Misener and MacLeod (1988) modified a horizontal cup belt fed, two-row Setrite planter (Smallford Planters Ltd., St. Albans, England). Modifications included adding a second drive system allowing each row to be driven independently and the addition of sprocket clusters enabled seed piece spacings to be adjusted from 165 to 500 mm in intervals of 35 mm. The COV of various seed piece spacings achieved by the modified Setrite planter ranged between 32.8 and 41.1%. The modified Setrite planter was three point Hitch mounted, heavy, and required a tractor of at least 60 kW. Misener and MacLeod (1988) concluded that with modifications the Setrite planter performed well. However, the Setrite planter is no longer commercially available.

The goal of this project was to build a small plot two-row potato planter that enabled precision spacing of seed, rapid adjustment for seed piece spacings, and planting individual rows with different varieties, different seed piece spacings, or different fertilizer rates.

At potato research and extension centres, hand planting small field plots is often required, a labour intensive and costly operation. Commercial potato planters are generally unsuitable for research plot work requiring precise in-row seed spacing. Two-row commercial planters do not permit rapid in-row seed piece spacing adjustments or planting adjacent rows using different varieties, seed piece spacings, or fertilizer rates. The accuracy of in-row placement of seed pieces is affected by the mechanical design of a potato planter. Misener (1982) indicated that the coefficient of variation (COV) for seed placement of various commercial planters operating on farms could range from 48.2 to 86%; which is considered unacceptable for potato research plantings.

Commercial planters have been modified for planting research plots. Misener and MacLeod (1988) modified a horizontal cup belt fed, two-row Setrite planter (Smallford Planters Ltd., St. Albans, England). Modifications included adding a second drive system allowing each row to be driven independently and the addition of sprocket clusters enabled seed piece spacings to be adjusted from 165 to 500 mm in intervals of 35 mm. The COV of various seed piece spacings achieved by the modified Setrite planter ranged between 32.8 and 41.1%. The modified Setrite planter was three point Hitch mounted, heavy, and required a tractor of at least 60 kW. Misener and MacLeod (1988) concluded that with modifications the Setrite planter performed well. However, the Setrite planter is no longer commercially available.

The goal of this project was to build a small plot two-row potato planter that enabled precision spacing of seed, rapid adjustment for seed piece spacings, and planting individual rows with different varieties, different seed piece spacings, or different fertilizer rates.
Fig. 1. Small plot potato planter - key components and layout per row.

Planter evaluation
Planting performance data were collected as per the procedure used by Misener (1982). Cut and whole seed pieces with average masses of 97 and 45 g, respectively, were planted in separate rows 30 m long. Seed piece spacings were measured to the nearest 10 mm from centre to centre of adjacent seed pieces. The COV’s for whole and cut seed planted at 203, 254, 305, 406, and 457 mm seed piece spacing (Table I) were calculated and were lower than those reported for commercial planter shoe virtually eliminated all seed piece ground roll. The back frame of the conveyor belt was hinged and an adjustable front support enabled the front of the conveyor belt to be raised during transport.

Seating was provided for two operators, allowing seed pieces to be placed into each cup independently. In-row seed piece spacing was obtained with a variable speed adjustment gearbox (model Y-1, Zero-Max, Canimex, QC) with micro-dial controller, which controlled the conveyor belt speed relative to the ground speed. The micro-dial controller attached to the variable speed gearbox enabled rapid adjustment to achieve the precise seed piece spacing desired.

Small fertilizer hoppers combined with a chain-link discharge system, similar in design to commercial planters, was used when a uniform type or rate of fertilizer for both rows was required at planting. When planting per row required different types or rates of fertilizer, the hoppers were removed from the planter and a metal frame supporting two belt driven cones (model H80, Hege Equipment Inc., KS) was attached to the planter (Fig. 2). Bags containing the required fertilizer per treatment row were emptied into filling funnels attached above the cones. The fertilizer was evenly distributed along the outer edge of the cones as it dropped from the funnels to the cones. As the cones completed one rotation, all fertilizer was emptied from the cones through an opening at the bottom of the cones. The rotation of the cones was controlled by a variable speed gearbox (model JK, Zero-Max, Canimex, QC) with micro-dial controller that allowed for rapid adjustment of row length if required. Vinyl tubing, 22 mm inside diameter, was attached to the bottom of each cone and directed the fertilizer as it dropped to the furrows, which were made in a similar manner to the original planter. Since the planter was not equipped with hillers, a set of two disc hillers per row was mounted on the tractor and hilling was done after planting as a separate operation. A small 20 kW tractor was found sufficient to pull the planter. All operations were driven from countershaft drive pulleys, driven from the axles, that adjusted according to changes in ground speed. Ground speed ranged from approximately 1.6 to 3.2 km/h and was generally determined by the time needed to place seed pieces in cups on the conveyor belt.

Fig. 2 Small plot potato planter with cone fertilizer attachment.
Table I: Coefficient of variation (COV) of in-row seed piece spacings obtained by the small plot potato planter

<table>
<thead>
<tr>
<th>Desired seed piece spacing (mm)</th>
<th>Whole seed COV (%)</th>
<th>Cut seed COV (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>203</td>
<td>12.7</td>
<td>15.4</td>
</tr>
<tr>
<td>254</td>
<td>11.2</td>
<td>11.1</td>
</tr>
<tr>
<td>305</td>
<td>13.2</td>
<td>10.7</td>
</tr>
<tr>
<td>356</td>
<td>13.4</td>
<td>11.5</td>
</tr>
<tr>
<td>406</td>
<td>10.6</td>
<td>11.3</td>
</tr>
<tr>
<td>457</td>
<td>15.3</td>
<td>14.7</td>
</tr>
</tbody>
</table>

This planter performed well compared to other plot or commercial planters and to hand planting. The planter allowed for planting adjacent rows with different cultivars at different in-row seed piece spacing. It also more efficiently enabled planting at similar or different rates or types of fertilizer as required. Gearboxes with micro-dial controllers, used to control all planting operations, allowed for rapid adjustments at planting. With a range from 11 to 15%, the COV for in-row seed piece spacing was lower compared to other plot or commercial planters. Compared to hand planting, labour required to plant similar experiments with the planter was reduced 50%. Further details concerning the planter components and layout can be obtained by contacting the authors.

ACKNOWLEDGEMENT
The authors thank A. Malone for technical assistance and R. Campbell, Prince Edward Island Department of Agriculture, Fisheries and Forestry for his drafting assistance.

REFERENCES