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Influence of Various Parameters of Potato Planter on the Performance of Metering Mechanism

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INTRODUCTION

Agriculture mechanization plays very important role for horticulture crops. To reduce the labour scarcity, labour drudgery, time consumption in manual planting of potatoes, a prototype was designed, fabricated and evaluated in the field. The study was carried out at IGKV, Raipur in the year 2019-20. The developed planter consists of seed metering device, seed tube, seed tuber covering duct, fertilizer tube, seed and fertilizer hopper. There were three levels of each machine parameters i.e., shoe type furrow opener angles (S_1, S_2, S_3), drive wheel sizes (W_1, W_2, W_3) and the machine was operated at three speeds (V_1, V_2, V_3).The combined effect of independent parameters i.e., a) different peripheral speeds V_1 (1.5 km/h), V_2 (2.0 km/h), V_3 (2.5 km/h); different angle of shoe type furrow openers S_1 (45°), S_2 (90°) and S_3 (120°) and different drive wheel sizes i.e., W_1(38cm), W_2(42cm) and W_3(52cm) on the dependent parameters as performance of metering unit in terms of i) percentage singles, ii) percentage doubles, iii) percentage multiples, iv) percentage missing's and v) percentage damages were studied, discussed for each selected shapes of potato tubers and described below;

Effect of the forward speed on uniformity index:

It was observed that the mean tuber spacing increased with the increase in the forward speed. Also, tuber spacing uniformity is the best under low forward speed (1.5 km/h) and followed by medium forward speed (2.0 km/h) as indicated by CV values. This was also confirmed by the values of the multiple index (MULTI), the miss index (MISI) and the quality of feed index, that the best values of these indexes were observed at low forward speed. It was also observed that there were no significant variances between the performance of the tested potato planter when operated at 2 or 2.5 km/h as indicated by the multiple indexes, missing index (MISI) and the quality of feed index (QFI).

Conferring to these results, the tested planter could be efficiently operated at a forward speed of 2.5 km/h to get higher field capacity (comparatively to other linear speeds), while not significant affecting seed tuber uniformity.

Effect of tuber size on spacing

The increase in tuber size caused slight increase in the mean tuber spacing as presented in table and there were no significant variations noticed in the mean tuber spacing as a result of tuber size. While, the influence of tuber size on tuber spacing uniformity was found to be significant as indicated by the values of CV, multiple and missing indexes. The 35 to 45 mm sized tuber induced maximum multiple values than other sizes as oval (oblong + long-oblong). Also, it was observed that there are significant differences between the multiple values when using tuber size of 35-45 mm and 55-65 mm (oval shapes). The missing value increased by 5.23 and 10.56 % when the tuber size of 35-45 mm was used instead of 45-55 mm (oblong) and 55-66 (long-oblong) mm respectively. For all test parameters, the lowest and similar value of the coefficient of variation for all the shapes spacing were observed. Therefore, based on the seed spacing uniformity data, the performance of the tested cup-chain potato planter is the best for small as well as larger seeds.

Effect of tuber shape

The results indicated that tuber shape effects on the mean tuber spacing were statistically significant. Round (spherical) shape induced significantly lower mean tuber spacing than oval shapes. Regarding tuber spacing uniformity, it was observed that tuber shape induced a significant difference between the values of CV and MISI. While the effect of tuber shape on the MULTI and QFI indexes was not significant. These observations could be attribute to that the flow of tuber from the tank to the feeding cups is expected to be better with round shape and that will enhance the possibility for the cups to be filled by tubers. Obviously, the use of spherical shape for seed tuber will improve the uniformity of seed spacing.

Percentage of singles and doubles

Singles and doubles indices for round, oblong and long-oblong potato seeds at different speed is shown in Fig. A, B and C. Percentage of singles and doubles affected by the speed of operation of the potato planter. Percentage of double slightly increases with speed increased. Percentage of singles and doubles is mainly affected by the size of cups, metering mechanism and the speed of operation. percentage singles were maximum as 86.43 ± 0.84 per cent at the speed of 1.5 km/h followed by 85.97 ± 1.08 per cent at the speed of 2.0 km/h and 84.63 ± 2.02 per cent at the speed of 2.5 km/h respectively. The higher per cent of doubles was found in case of 2.0 km/h as 10.97 ± 0.96 per cent followed by 9.93 ± 0.97 per cent at the speed of 2.5 km/h and 9.57 ± 1.28 per cent at the speed of 1.5 km/h respectively.

Multiple percentage

Multiple indices for round, oblong and long-oblong potato seeds at different speed is shown in Fig.4.35, 4.36 and 4.37. It was found that maximum multiple indexes were in 2.0 km/h, since the dropping rate of seed was highest as compared to other. Hence seed to seed spacing was reduced. Multiple indexes were observed 5.37 ± 0.44 per cent at 2.0 km/h whereas 4.67± 0.56 per cent and 4.38 ± 0.68 per cent at 1.5 and 2.5 km/h respectively.

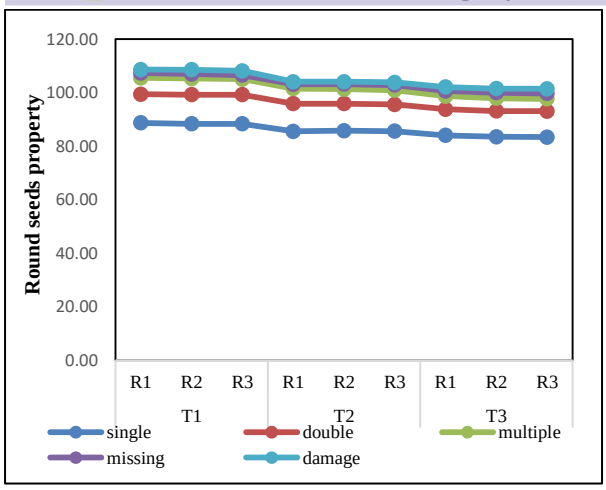

Fig. A. Values of percentage single, double, multiple, missing and damage for round tubers

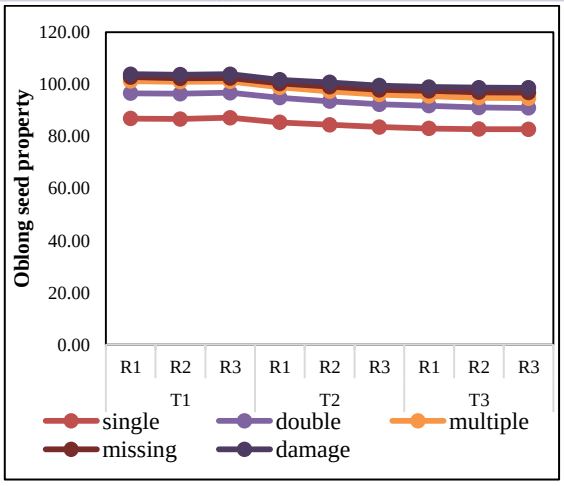

Fig. B. Values of percentage single, double, multiple, missing and damage for oblong tubers

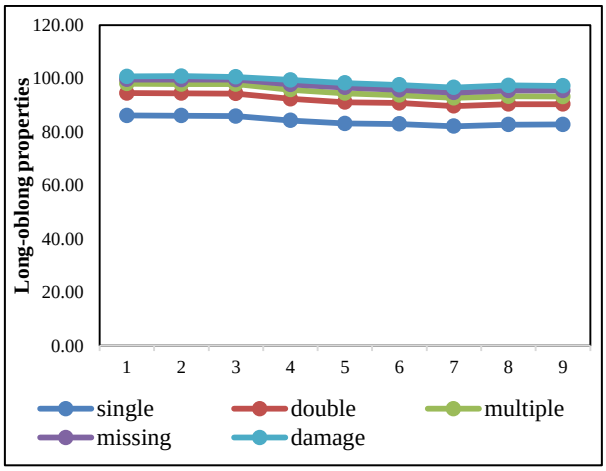

Fig. C. Values of percentage single, double, multiple, missing and damage for long-oblong shapes

Missing percentage

Missing indices for round, oblong and long-oblong potato seeds at different speed is shown in Fig. A, B and C. Percentage of missing slightly increased as speed increased. Percentage of missing also affected by the size of the cups, metering mechanism quality and operational speed of the planter. Minimum missing percentage were observed 1.84 ± 0.26 at speed 1.5 km/h, 2.47 ± 0.24 per cent at 2.0 km/h and 2.59 ± 0.47 per cent at 1.5 km/h.

Effect of ground wheel diameter on seed spacing

During the operation of the potato planter in the field it was noticed that as lesser the diameter of the transmission wheel (drive wheel) as closer the spacing between two consecutive seeds. With larger diameter of wheel, the planter delivers the tuber at greater spacing but in acceptable limits as 20 to 22 cm spacing. With 52 cm of diameter wheel the spacing of tubers was 20-22cm but in uniform. There were no significant variation between the diameter of 38 cm and 42 cm of ground wheels, the spacing between two consecutive tubers was ranges from 12-15 and 15-18 cm respectively and these were in suggested limits.