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Performance evaluation of green pea depoder machine

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Abstract
Pea is one of the important cool season crops grown in Jharkhand. The depoding of pea pods is essential for consumption, further processing and value addition of peas. A small scale manually operated green pea depoder machine was developed to depod the green pea pods. This machine works on the principle of friction generated due to rubbing action of hammer pads with pea pods against the inner surface of sieve frame and impact action of pads. The machine was tested for its performance evaluation by the varying the gap between tapered sieve and hammer pad. Testing of machine was carried out at two different settings. The best result was obtained at second setting. The moisture content of fresh pea pods used for the depodding was 82% (w. b). Based on performance evaluation analysis, the depodding efficiency and damaged seeds percentage of the machine were found to be 96.75% and 2.17% respectively. The average throughput capacity of the machine was found to be 15.47 kg/h. This machine could help pea growers to increase their income.

Keywords: Green pea, depoder, hammer pad, taper sieve, depodding efficiency, capacity

Introduction
Green peas (*Pisum sativum* L.) is an important winter vegetable crop. It is also known as Hara Matar in India. Pea is an annual plant, with a life cycle of one year. In India, pea is generally sown in Rabi season from the beginning of October to mid of November in the plains and from middle of March to end of May in the hills (Anon, 2015c) [2]. Green vegetables are the essential items of our daily food. It is an important leguminous vegetable and occupy important place among the vegetables. Pea is one of the most important cool season vegetable crops grown throughout the world (Agropedia, 2015) [1]. Green peas or garden peas (matar) hold remarkable place due to its highly nutritional value. Nutritional content of fresh peas are protein (25%), amino acids (12%), carbohydrates (16%), Vitamin A and C, Calcium, Phosphorus and small quantity of Iron. India is one of the largest producers of field pea in the world and stands at the 5th place in the list of major field pea producers. In India, peas are mainly grown in Uttar Pradesh, Madhya Pradesh, Himachal Pradesh and Jharkhand. Pea is an important cool season, leguminous crop of Jharkhand. Jharkhand stands 2nd in pea production in India and contributes 8.94 per cent of the total production of India. Jharkhand contribute to 6.4% of total pea production in the country. The outer cover of green peas is comparatively harder. The shell is unfit for human consumption. The shelling pea pods are essential to get pea seeds for utilization. Removal of kernel from green pea pods takes lot of time. Normally after harvesting pea pods from their plants, the pea seeds are manually separated from their pods. Such procedure of manual threshing is labour-intensive and very much time-consuming. Due to urbanization, demand of shelled and frozen peas has been increased tremendously. Manual removal of pea kernels from pods is a laborious and time consuming job with one person depoding about 3-3.5 kg of pea kernels from pods in one hour (Sharma and Mandhyan, 1988) [4]. The depodding machine is useful for depodding pea pods. The depoding machine not only helps to reduce the time for depoding of pea pods, but can also be used as a good opportunity for small farmers. A small scale manually operated green pea depoder machine has been developed to depod the green pea pods. A manually operated green pea depoder can meet the requirement of the pea growers at the cottage level. The testing of machine is essential to find out the performance.

The present study was undertaken to evaluate the performance of green pea depodding machine to suit the requirement of green peas grower interested in starting small scale peas processing industry.

Material and Methods

Performance evaluation of green pea depoder machine

The experiments were conducted to evaluate the performance of the pea depoder machine developed under AICRP on Post Harvest Engineering and Technology, Department of Agricultural Engineering, Ranchi. The machine consists of main frame, main shaft, block bearings, sieve frame, sieve, hammer pad assembly, rotor, roller and roller pins, gear mechanism assembly, hopper, trash guider and body cover. The main shaft, connected to rotor, is driven manually through handle, which rotates the tapered sieve frame in opposite direction through gear mechanism assembly. The roller mechanism was used to provide free rotation to the sieve frame. Fresh green pea pods were obtained from local market of Kanke, Ranchi and stored at 4 to 5 ºC temperature in a refrigerator. The moisture content of fresh pea pods used for the depodding was 82% (w. b). The shelling of green pea pods was performed taking 1 kg sample. Pea pods were fed through hopper for shelling operation. After shelling operation the machine was stopped and different fraction like unshelled pods. Shelled pods, whole kernels were collected and weighed. The machine was evaluated at the speed of 40 revolutions per minute manually by rotating handle of the machine. The performance of the machine was evaluated based on its throughput or capacity, depodding efficiency, whole grain efficiency and overall depodding efficiency during operation. The testing was carried out by **v**arying the gap between tapered sieve and hammer pad. The suitable gap was maintained by shifting hammer pad wheel. Four experiments were carried out at each setting and mean values were used for computation of performance evaluation parameters. The green pea pods were weighed and fed into the tapered sieve through the hopper. During operation, the pea seeds were passed through the hole of taper sieve and husk were collected in tray. The shelled green pea seed were collected and separated in two categories. The two categories were damaged seed and undamaged seed. In 1st arrangement, the gap between tapered sieve and hammer pad was kept 40 mm (Fig. 1) to find its output performance. In this test, seed breakage was observed as clearance between taper sieve and hammer pad was less as compared to dimension of green pea. In 2nd arrangement (Fig. 2), the gap between 1st to 2nd was kept 25 mm, 2nd to 3rd was kept 30 mm, 3rd to 4th was kept 30mm and 4th to 5th was kept 35 mm.. The green pea depoding machine during operation is shown in Fig. 3.

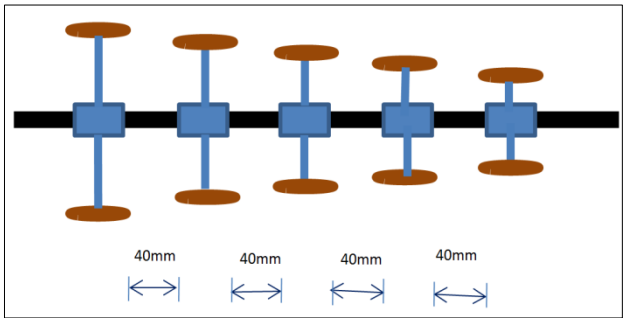

Fig 1: Position of shaft and hammer pad assembly

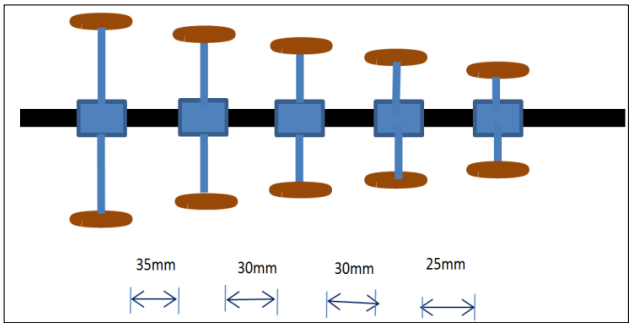

Fig 2: Final Position of shaft, hammer pad assembly

Fig 3: Green pea depoding machine during operation

Capacity of green pea depoding machine

The output capacity was estimated by weighing the total seed (whole and damaged) received per hour at main outlet output of the depodder machine using the following equation (Shaik, 2014 and Sonboier *et al*, 2018) [5, 7]:

Capacity (kg/h) = Weight of pods (kg)/time of operation (h)

The damage percentage and unshelled pod percentage were calculated using the following equations:

Damage percentage = [mass of damage seed x 100]/total mass of pod

Unshelled pod percentage=[mass of unshelled pod x 100]/total mass of pod

Efficiency of green pea depoding machine

Efficiency of depoding is another important parameter for evaluating the performance of the depoding machine. The depodding or shelling efficiency of the machine was calculated using the following equation (Singh, 2003 and Kamboj *et al*., 2012) [6, 3]:

$$Shelling\ Efficiency = \left[1 - \frac{mass\ of\ unshelled\ pod}{total\ mass\ of\ pod}\right] \times 100$$

Results and Discussion

A small scale manually operated green pea depoder machine was tested for its performance evaluation by the varying the gap between tapered sieve and hammer pad. Two setting were used for testing the machine. The average values of the depoding capacity, depoding efficiency, damage percentage and undepod percentage are shown in Table 1. From Table 1, it is clear that depoding efficiency and capacity are more in second setting while damage percentage and undepod percentage are less which is desirable characteristics of machine. The depoding efficiency and capacity were found to be 96.75% with 2.17% damage pea. The undepod percentage of the machine was found to be 3.25% for second setting while for first setting it was 6.25%. The average capacity of machine was found to be 15.47 kg/h. The overall weight of the whole machine was 40 kg. The second setting was found suitable as the breakage of pea was less as compared to first setting and other desirable performance evaluation parameters were more. Hence, the second arrangement is best suitable for operation.

Table 1: Performance evaluation of the green pea depoding machine

Setting	Depodding Capacity(Kg/hr)	Depodding Efficiency (%)	Damage Percentage (%)	Undepod Percentage (%)
1	15.20	94.30	4.6	5.7
	14.60	93.50	5.3	6.5
	15.70	93.90	6.1	6.1
	14.90	93.30	5.8	6.7
Mean	15.10	93.75	5.45	6.25
2	15.6	95.46	2.4	4.54
	16.2	96.53	2.3	3.47
	15.3	97.26	2.1	2.74
	14.8	97.77	1.9	2.26
Mean	15.47	96.75	2.17	3.25

Conclusion

A small scale manually operated green pea depodder machine was developed to depod the green pea. This machine works on the principle of friction generated due to rubbing action of hammer pads with pea pods against the inner surface of sieve frame and impact action of pads. The machine was tested by the varying the gap between tapered sieve and hammer pad. The depodding efficiency of the machine was found to be 96.75% while the capacity was found to be 15.47 kg/h. The damaged seed percentage was 2.17%. The developed depodding machine could be operated by farmers efficiently and save time. Using this machine, farmers could increase their income and depodded peas could be used for further processing.

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