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Studies and performance of a garlic planter in Uttar Pradesh

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■ **ABSTRACT :** The main concept of design and development of garlic planter is fabrication, the drilling planter and its metering device are simple in their structure and easy to manufacture. This study followed research after the 3 types of garlic planter was fabricated in 2001 which included; 1) inclined metering plate garlic planter, 2) vertical metering plate garlic planter and 3) spring plate garlic planter. In this study, 2 model were constructed which included; 1) The vertical metering plate with triangular grooves and 2) The bucket type garlic planter. The uniformity of metering system test for the 2 models, the bucket type garlic planter presented the most impressive results. The percentage of broken was very low, about 0.25 per cent. The new prototype garlic planter had 10 rows and was attached to 5 HP power tiller. The garlic planter was tested under actual field conditions at meeting district, Allahabad. The result indicated that the optimum width of garlic planter was 0.9 meter or 9 rows. The suitable soil condition was dry soil. Farmer should apply water after planting. The maximum forward speed was 3 km/hr and wheel skid was high about 24.34 per cent. The average depth and width of planting was 2.65 cm. and 4.68 cm. Time for turning at head land was 39 seconds. The field capacity was 0.32 ha/hr and there were three operators. Hence, the capacity of planter was 0.84 ha./man/day.

■ **KEY WORDS :** Garlic planter, Drill planter, Metering device, Bucket metering, Hopper, Measuring instruments

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Garlic is grown in the world over 12.25 lakh hectares (lh) with 156.85 lakh tones (lit.) production which translates into 12.80 tones/ hectare productivity. India is one of the largest producers of spices in the world and leads the production table in many spices including garlic. Garlic was grown in India in 2007-08, over 1.68 lh with 8.3 lit. production. The production has been grown on the central reign. In 2004, the production of garlic was 127,426 tons and the value was 2,544 million baths. Garlic is an economic crop which trend of export is upwards.

Farmer starts to plant in the early of winter (from end of October to February). After preparation of soil the grower will put the cloves in the saturated soil. Cloves are planted vertically with the basal root plate down and space between cloves in rows about 10 cm. After plant by hand, farmers cover the beds with rice straw to maintain moisture. In planting garlic, the major problem is a very expensive payment for employment of man power to plant by hand. The capacity of man power is very low about 0.06 ha./man/day, and payment for planting is 12.9 per cent of total cost of production. According to the problems above, the development of garlic planter has been started by Jiraporn *et al.* (1999). After the gathering of data about traditional garlic planting method, the study of effect of planting method to yield were tested

in the farmer field. The result shown that the drilling method was appropriate for fabricate the garlic planter (Jiraporn and Sanyaluck, 2002). Hence, the design and development of garlic planter was started with the concept of the drilling planter attached to 5 HP power tiller and evaluation of the efficiency of 3 types of garlic planter's precise. Gujarat is the leading garlic producing state with production of 2.28 lakh tones (08-09) accounting 26 per cent of total production and yield of 6.89 tone/ha. Uttar Pradesh ranks second with production of 1.89 lit. followed by Madhya Pradesh (1.67 lit.). Punjab is the state with the highest yield at 14.73 tone/ha. Karnataka, Bihar, Tamil Nadu, Punjab, Haryana and Andhra Pradesh also produce a sizeable quantity of garlic in cooler regions of the states.

Study and evaluation of the efficiency of 3 types of garlic planter's precise.

Fig. A : A view of inclined plate garlic planter

Fig. B : A view of verticle plate garlic planter

Testing and evaluation of the 3 types of garlic planter in the field :

The test method for determination of performance used the uniformity of seed metering test and 3 mechanical

Fig. C : A view of spring plate garlic planter

damage tests to compare the result. In making an assessment of drill performance it is necessary to consider 1) seed rate, 2) percentage of the broken and 3) coe-fficient of variance. The test was run at forward speed 3 levels *i.e.* 1, 2, 3 and 4 km/hr.

Table A : The test method and criteria

Test method	Criteria
Uniformity of metering devices	Quantity of seed dropped per meter is 11 and variation in quantity does not exceed +4 or -3.
Mechanical damage	The percentage of visible damage to seed after drilling shall not exceed 6% when compared with before drilling.

Design and development of metering devices :

Design of the vertical metering plate with triangular grooves.

The prototype was adapted from the vertical plate planter with 2 rolls in the metering system. Design of size, shape of grooves and 2 brushes were located to remove the seed over the grooves and assign the position of released point of seeds. A schematic view for new

Fig. D : A view of New vertical plate metering system

vertical plate metering system presented in Fig. D.

Design of bucket type metering system :

Based on reducing seed broken, it was hypothesized that a bucket type could be caused garlic cloves damage less than the vertical metering plate. The following presents a schematic view of bucket type metering system (Fig. E).

Fig. E : A view of bucket type metering system

Comparison test and development of the bucket type for the process of planter :

The comparison of metering system performance between new vertical plate planter and bucket type planter :

Tested the uniformity of the metering systems and checked percentage of the broken after operating the planter at the revolution of seed metering as 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110 and 120 rpm.

Comparison of the appropriate bucket size :

Tested the uniformity of the metering device using 2 sizes of bucket, 10 and 13 mm. depth. The test was done at the revolution of seed metering as: 40, 50, 60, 70, 80, 90, 100, 110 and 120 rpm.

Fabrication of the 12 – row garlic planter and testing in field :

Fabrication of the 12-rows garlic planter attached to the power tiller :

The design conditions are based on the results from the experiment and the study earlier. The conditions are as followings :

– The bucket type metering device was used to fabricate the 12-rows garlic planter.

– The depth of bucket was 13 mm.

– The suitable revolution of metering system was 40 to 80 rpm at travel speed 2 to 3 km./hr.

– Shoe type furrow opener was selected for fabrication of the 12-rows garlic planter.

– The optimum width was calculated from optimum width equation (Huntdonnell,1995). The solution of this equation is 1.2 meter or 12 rows.

Based on these results, the 12-rows garlic planter was designed and fabricated (Fig. F).

Fig. F : A view of 12 row garlic planter
Specification of garlic planter.
- Dimension width x length x height : 1250 x 925 x 705 mm
- Bare weight 150 kilograms

Field test :

Field test of the garlic planter was conducted to determine the performance of planter under the actual field conditions at meeting system in district, Allahabad. Land preparation was done by 1 travel of rotary tiller. The field plot was 4.2 meter width, 29.9 meter length. It is sandy soil and the soil moisture is 18.31 per cent dry basis. The purpose of this test was determination the parameters including the optimum width, the soil moisture level that was suitable for the planter and the appropriate travel speed.

The testing procedures are summarized as the following:

– Assigned three levels of the garlic planter speed.

– Two levels of the soil moisture were dry soil which was watered one day before planting. - Ease of operation assessed the optimum width.

The evaluation of the efficiency of 3 types of garlic planter (Table 1).

The number of the cloves per meter and the percentage of the broken were used to evaluate. The vertical plate garlic planter was selected for modification as shown on Table 2.

– Inclined plate garlic planter
– Vertical plate garlic planter
– Spring plate garlic planter

The comparison of metering system performance between new vertical plate planter and the bucket type planter (Table 3).

From the data, it appeared that the bucket type garlic planter was better than new vertical plate planter. By checking the percentage of the broken, is found that both of them have percentage of the broken not exceeds 5 per cent. The bucket type garlic planter was better because its maximum percentage of the broken was 0.24 per cent at the speed of 50 rpm. When compared the co-efficient of variance, we found that the bucket type garlic planter had less value, about 9.98 to 15.76 per cent, than the new vertical plate planter which had the value about 11.19 to 39.45 per cent (Table 4).

– The uniformity test of the metering system to find the appropriate size of the bucket between 12 mm. depth and 14 mm. depth.

From the experiment, we found that the 12 mm. bucket depth delivered maximum seeds 10.08 cloves per meter at speed 50 rpm only. Other speeds could not deliver seeds upto 10 cloves per meter which was the target seed rate. The 14 mm. bucket depth delivered seeds more than 10 cloves per meter which vary in range 13 to17.18 cloves per meter. When compared the coefficient of variance, we found that 14 mm. bucket depth had the value in the range 15.25 to 26.2 per cent and 12 mm. bucket have the value in the range 14.4 to 44.52 per cent (Table 4). The conclusion is that the suitable depth of bucket is 12 mm.

Based on the overall experiment, we conducted the concept of garlic planter design as:

– The metering device of the garlic planter is the bucket type.
– Depth of the bucket is 12 mm.
– The revolution of the metering device is in the range 40 to 80 rpm.

Table 1 : The testing of the performance for 3 types of the garlic planter

Forward speed	Average seed rate (cloves/ meter)			Average percentage of the broken		
km/hr	(1)*	(2)*	(3)*	(1)*	(2)*	(3)*
Full hopper						
2	12	35.18	15	8.32	0.9	5.73
3	10.2	20.86	20.67	13.62	1.18	13.52
4	7.1	14.66	15.29	17.47	1.66	14.55
Half hopper						
2	15.5	25.45	18	9.84	8.11	7.63
3	6.5	20.5	18.94	24.69	3.85	8.73
4	5.33	11.78	18.44	38.7	7.12	19.44
Quarter hopper						
2	15.6	25.46	19	10.83	9.11	8.63
3	5.8	20.55	19.95	25.69	3.88	9.73
4	5.55	10.77	17.42	37.70	7.13	20.41

Table 2 : Summarized the problems of each prototype

Prototype	Problem
Inclined plate garlic planter	Overflow of the garlic cloves on the seed plate caused unsmooth of transmission. The peripheral speed of the seed plate was too high and caused mechanical damage upto 35%.
Vertical plate garlic planter	Too large groove caused the over seed drill 31 cloves per meter. The percentage of the broken was about 6%.
Spring plate garlic planter	Unsmooth of the metering unit and clogging of the garlic cloves at the release point of the hopper caused high percentage of the broken about 14%.

Table 3 : The uniformity of the metering systems of 2 types of the garlic planter

Revolution of metering unit (rpm)	Average seed rate (cloves per meter)		Percentage of the broken		Co-efficient of variance (%CV)	
	New vertical type	Bucket type	New vertical type	Bucket type	New vertical type	Bucket type
10	*	**	*	**	*	**
20	36.39	**	0.6	**	14.9	**
30	33.61	**	0.33	**	11.19	**
40	34.06	44.33	0.36	0.12	18.97	9.98
50	28.11	45.61	0.15	0.23	14.64	10.22
60	24.89	45.44	1.1	0.12	22.24	9.99
70	16.56	40.89	0.31	0	21.26	13.2
80	9.72	41.72	0.36	0.15	39.45	13.79
90	12.56	42.67	1.91	0	32.81	14.73
100	0	31.61	0	0	0	11.04
110	0	25.5	0	0	0	15.47
120	0	27.72	0	0	0	15.76

* The speed was too slow and caused the testing set (sticky belt) fail.
** The speed was not high enough to test the bucket type garlic planter.

Table 4 : The comparison of the uniformity of the metering system using the buckets of 12 and 14 mm. depth

Revolution of metering unit (rpm)	Average seed rate (cloves per meter)		Co-efficient of variance (%CV)	
	12mm bucket depth	14mm bucket depth	12mm bucket depth	14mm bucket depth
40	8.95	16.18	19.65	18.08
50	10.08	14.45	24.33	19.42
60	8.40	17.18	14.4	20.59
70	8.74	16.06	20.37	15.25
80	8	13.84	27.44	22.5
90	5.35	12.79	30.50	21.32
100	6.46	11.95	33.82	26.2
110	5.7	12.69	44.52	17.13
120	6.08	13	32.78	23.15

Table 5 : Test

Sr. No.	Problems	Implementation	Notes
Laboratory test			
1.	Percentage of the broken of 3 types of the garlic planter was too high. (Mechanical damage upto 35%)	Developed the new vertical plate garlic planter and the bucket type garlic planter. Test the uniformity of each metering system.	After testing, we selected the bucket type garlic planter because its low mechanical damage (Max value is 0.23%)
2.	Seed rate of the bucket type garlic planter was too high (About 26-46 cloves per meter)	Reducing bucket volume 67.9%	Seed rate was about 11-16 cloves per meter
Field test			
3.	Seed size variation could cause the problem of logging in the metering system		
4.	Others conditions which cause the error on the field test	Change of the bucket shape.	
4.1	Land preparation was not completed	Should plow at least 2 times for rotary tiller. Rearrange the opener to make more space. Reduce the operation with from 12 row to 8 rows. Fabricate the covering device separate from the opener. Transmit driving power directly from power filter	
4.2	The design of some parts was not suitable for farmer's field		
	Locating the furrow opener (Space between opener was not large enough for soil movement)		
	The operation width of the garlic planter was too large		
	Covering devices were not performed well		
	Slip of ground wheel was too high		

Fig. 1 : Bucket A (made from plastic pipe, 19 mm. diameter)

Fig. 2 : Bucket B (new bucket shape)

Field tests :

Under the field condition 12-row garlic planter was performance evaluation at 2.62 cm. depth, 4.66 cm. width and the forward speed of 2.63 km/hr. The draft planter was too high so the number of 12 rows was reduced to 8 rows. Hence, the 8-row garlic planter was tested in the farmer field. The optimum width of the garlic planter was 0.8 meters or 8 rows. The suitable soil condition was dry soil. And the farmer should apply water after planting. The maximum forward speed was 4 km/hr and the wheel skid was high about 23.32 per cent. The average depth and width of planting was 2.62 cm and 4.66 cm, respectively. The time for turning at head land was 38 seconds. The field capacity was 0.32 ha/hr and there were 3 operators. Hence, the capacity of planter was 0.83 ha/man/day.

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