# The 8-rows Garlic Planter installed with 5-HP Engine Power Tiller

Somchai Praditsuwan[1], Charatchai Yenphayab[2] Sonyaluck Kingthong [3]
and Jiraporn Benjaphragairat[4]
[1] Master student, [2,3] Lecturer, [4]Associate Professor
[1,3,4]Agricultural Engineering Department, Faculty of Engineering, King Mongkut's Institute of Technology Ladkrabang , Bangkok, Thailand 10520.
[2]Agricultural Engineering Department, King Mongkut's Institute of Technology Lardkabang Chumphon Campus, Chumphon , Thailand 86160.

## Abstract

The design and development of a garlic planter installed with 5 hp engine power tiller has been started by the surveying of garlic cultivation and farmer requirement. The experimental on plantation methods were reported that the garlic planter should be designed a drilling method. Spacing between cloves and row are 10 cm. The development of metering systems were aimed at the least seed damage and the accuracy of seed spacing. After developed 7 models of garlic planters were fabricated and tested(from B.E 1999- 2003). The most impressive model was 8-row garlic planter with a plastic bucket disk metering system. The bucket disk with 6 triangular plastic buckets located at the peripheral disk. Each bucket has 80 degree scoop angle. The furrow opener of planter is shoe type. In laboratory test, it found that the appropriate speed of the power tiller engine was 1300 rpm at gear No.1. In field test, the best land preparation is 1 travel of rotary tiller. The average forward speed of planter is 1.68 km/hr whereas its field capacity is about 1.08 ha/day and average seed spacing is about 11.73 cm. Moreover, the average percentage of slip is found to be 10.36 while the percentage of the germination and average yield are found to be 74.57 and 13,856 kg/ha , respectively. The economic analysis have shown that the break even point of this planter is approximately 0.32 ha.

**KEYWORDS**: Garlic Planter , Drill Planter, Metering device

## Introduction

Design and development of the garlic planter have been started since 1999. The 12 rows garlic planter was introduced to the farmer field and tested at Maetang distict Chieng-Mai Province,2002. The problems were found that 1)the garlic cloves clogging in metering system (bucket chain), 2)working width,1.2,was completely problem for U-turn at headland 3)attachment to power tiller cause an working inconvenient, 4)used ground wheel had the high slip, 5) 1 set of the furrow opener cause the soil block up and 6)the covering device installed the same unit with furrow opener caused to the soil block up. Therefore designing and fabrication of the 8-rows garlic planter to solve the problems above.

# Objective

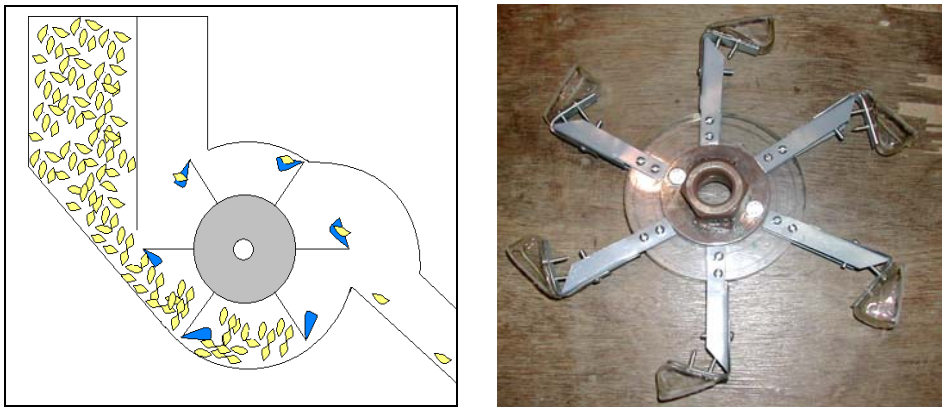
1. Testing and evaluation of the 8-rows garlic planter for precision planting (spacing : 10 cm.), reduce clove damage.

## Material and Method

Then the 8-rows garlic planter was introduced. Testing and evaluation was conducted an order to improve the garlic planter performance.

1.Design and development of the 8-rows garlic planter

1.1) Design metering device was bucket type that used the theory of Design of Roller type Metering Device [2] to application cause emphasis size and shape of the bucket fitting for garlic shape. Designed of plastic bucket disk show that in figure 1(a,b)



a)bucket disk metering device b)plastic bucket disk

**Figure 1** plastic bucket disk metering system

1.2) metering system working width to 0.8 m. , 8 rows reduced of the later machine. (12 rows)

1.3) Installed on power tiller behalf of attached to its.

1.4) Designed the metering device, travel speed of prototype should be equal to horizontal velocity of clove from the metering unit but in opposite direction.

1.5) Used transmitting from driving wheel to metering device replaced for driving from ground wheel to reduced the slip problem.

1.6) Used shoe type furrow opener and add the position to 2 sets as the front set and the back set to reduced the soil block up in front of the furrow opener.

1.7) Designed the covering was metal sheet connect to the back of furrow opener.

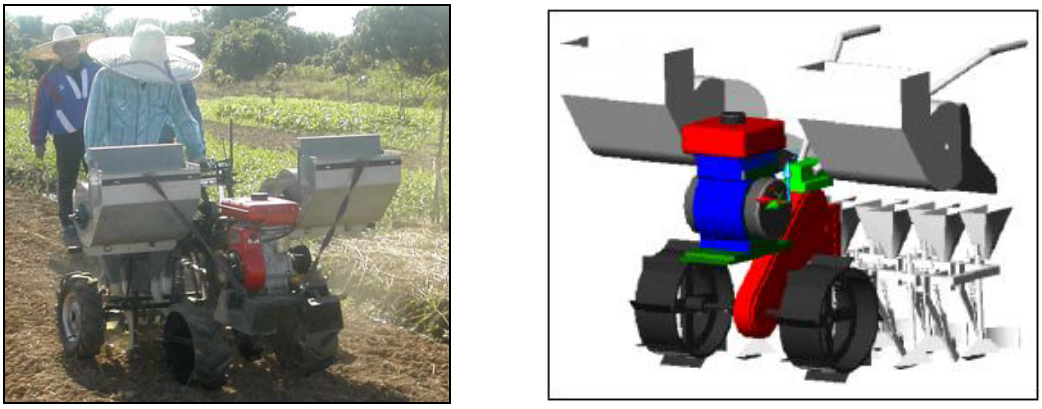


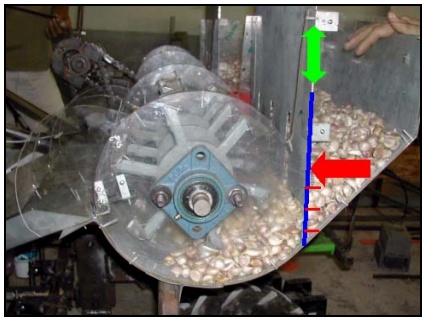
**Figure 2** The 8-rows garlic planter

**2.** Testing in Institute's field

After designed and fabricated then testing and evaluation was conducted in laboratory and Institute's field

2.1) Metering device system testing on sticky belt test rig, 10 m. length.

- Determine seed rate to consider average spacing between cloves.
- Determine percentage of clove damage.
- Variation of feeding opener at 3 levels of opener high 6,7 and 8 cm.
- Revolution of metering unit at 20-60 rpm. or at forward speed 1.0-3.0 km/hr As figure 3(a)



a) metering device tested

b) soil bin tested

**Figure 3** Laboratory tested

2.2) Soil bin tested.

- Determine cloves spacing and percentage of slipping.
- Set the revolution of machine at gear I;1200 rpm., gear I;1300 rpm. and gear II;1000 rpm. or at forward speed 1.5-3.7 km/hr As follow by figure 3(b)

2.3) Institute's field tested.

- Determine seeding rate and consider to cloves spacing
- Set the revolution of machine at gear I;1200 rpm., gear I;1300 rpm. and gear II;1000 rpm. or at forward speed 1.5-3.7 km/hr As follow by figure 4

**Figure 4** Institute's field tested

**Figure 5** Farmer's field tested, Mae-tang distict, Chiengmai province

**3.** Farmer field tested, Mae-tang distict, Chiengmai province,2002

-To study the new prototype.

-To Compare field capacity between 12 and 8.

-To Compare the 8 row planter with farmer plant both of planting and production.

-To test under the different field 3 type as 1, 2 and 3 tillage times show that in figure 5

## Result and discussion

**1.**The result from laboratory and Institute's field tested.

1.1)Metering device tested was found that

- Percentage of clove damage was zero.
- The uniformity for seed rate at opener gate was 7 cm. height given cloves space lug as 10.57 cm.

1.2) Soil bin tested

- The 8-rows garlic planter was to work by electric motor, 5HP,in soil bin 1 m. width 10 m. length. The result were posted on table 1

**Table 1** The average spacing between each cloves on soil bin

| Revolution of machine | Revolution of metering (rpm) | speed (km/h) | %slip | Average spacing (cm) |
|---|---|---|---|---|
| Gear I, at 1200 rpm | 38 | 1.46 | 12.54 | 7.33 |
| Gear I, at 1300 rpm | 48 | 1.85 | 13.74 | 7.79 |
| Gear II, at 1000 rpm | 117 | 3.71 | 30.12 | 6.13 |
| moisture content(%) | 1.72(%dry basis) | | | |
| soil type | Sandy soil | | | |

From this data showed that the average clove spacing in range from 6.13-7.79 cm. less than 10 cm. because of the higher slipping in range 12.54%-30.12%. From the result was found that the appropriate revolution of machine was Gear I, at 1300 rpm, had planting spaced as 7.79 cm. ,or at forward speed about 1.85 km/hr

1.3) Institute's field tested.

- Institute 's field, is heavy clay soil then consider from seed rate to planting spaced follow by Table 2

**Table 2** The average spacing between each cloves in the Institute's field

| Revolution of machine | Revolution of metering (rpm) | speed (km/h) | %slip | Average spacing (cm) |
|---|---|---|---|---|
| Gear I, at 1200 rpm | 40 | 1.4 | 23.7 | 7.9 |
| Gear I, at 1300 rpm | 44 | 1.62 | 19.89 | 7.93 |
| Gear II, at 1000 rpm | 90 | 2.67 | 34.91 | 4.5 |
| %moisture content | 4.14 % dry basis | | | |
| soil type | heavy clay/ MMD 24.95 mm. | | | |

From this data showed that the average clove spacing had show the same trend with the result of test in soil bin. From the result was found that the appropriate revolution of machine was Gear I, at 1300 rpm, or at forward speed about 1.62 km/hr, given the best clove spacing 7.93 cm.

**2.** The result of farmer's field Mae-tang distict, Chiengmai province,2002

- Tested in 3 different tillage field to find the appropriate time of tillage
- Set the revolution of machine at gear I; 1300 rpm, the average planting depth was about 1.5 cm**.** show on the table 3.

2.1) The result of working capacity of the prototype in farmer's field promoted on table 4.

**Table 3** Planting field condition

| field 's plot No. | 1 | 2 | 3 |
|---|---|---|---|
| size (width×length), meters | 3×26.7 | 2.5×27.4 | 3.33×26.8 |
| tillage, time | 1 | 2 | 3 |
| Soil type | sand soil (sand 91%,silt 9%,clay0%) | | |
| moisture content (%dry basis)/MMD(mm) | 11.64 / 5.7 | 9.68 / 6.98 | 11.88 / 7.01 |

**Table 4** The result of farmer field tested (planting day)

| Result | 1 | 2 | 3 | average | Farmer field |
|---|---|---|---|---|---|
| 1.total planting time(s) | 116 | 115 | 112 | 114 | - |
| 2. U-turn time(s) | 13 | 9 | 6 | 9.37 | |
| 3. forward speed (km/hr) | 1.68 | 1.65 | 1.70 | 1.68 | - |
| 4. slip(%) | 7.76 | 12.70 | 10.61 | 10.36 | - |
| 5. covering(%) | 87 | 93 | 99 | 93 | - |
| 6. planting depth(cm.) | 1.82 | 1.60 | 1.83 | 1.75 | - |
| 7. garlic rate(kg/ha) | 850 | | | | 625 |
| 8. field capacity(ha/day)/[ha/hr.] | 1.06-1.09 / [0.13] | | | | 0.4 / [0.05] |

2.2) Data for germination and harvesting

Number of seedling spacing were measured after planting 1 month. The data were taken 30 spacing for each plot. Number of seedlings per square meter were counted for three area of each plot as promoted on table 5 and 6

**Table 5** The garlic germination (1month later)

| result | 1 | 2 | 3 | average | Farmer field |
|---|---|---|---|---|---|
| 1. average plant /square meters | 84.25 | 84.25 | 80.5 | 83 | 81.8 |
| 2. germination(%) | 75.7 | 75.7 | 72.3 | 74.57 | 73 |
| 3. average plant spacing(cm.) | 12.23 | 11.29 | 11.68 | 11.73 | 11.8 |
| 4. require plant spacing (%) ,(TIS-standard)* | 32.9 | 39.2 | 40.5 | 37.53 | 71.78 |

note * require plant spacing in range 8-13 cm. [8]

**Table 6** Production of the garlic after planting 109 days

| result | 1 | 2 | 3 | average | Farmer field |
|---|---|---|---|---|---|
| 1. garlic bulb depth(cm.) | 2.83 | 2.91 | 4.45 | 3.39 | * |
| 2. garlic bulb size(GMD)(mm.) | 34.22 | 30.41 | 30.51 | 31.71 | * |
| 3. average plant weight(g.) | 46.89 | 25.91 | 32.07 | 34.96 | * |
| 4. product(kg./ha.) | 15,940 | 14,631 | 10,994 | 13,856 | 20,312 |
| 5. %the inclined plant | 5.14 | 6.27 | 7.51 | 6.39 | * |

* no information

2.3)Economical analysis

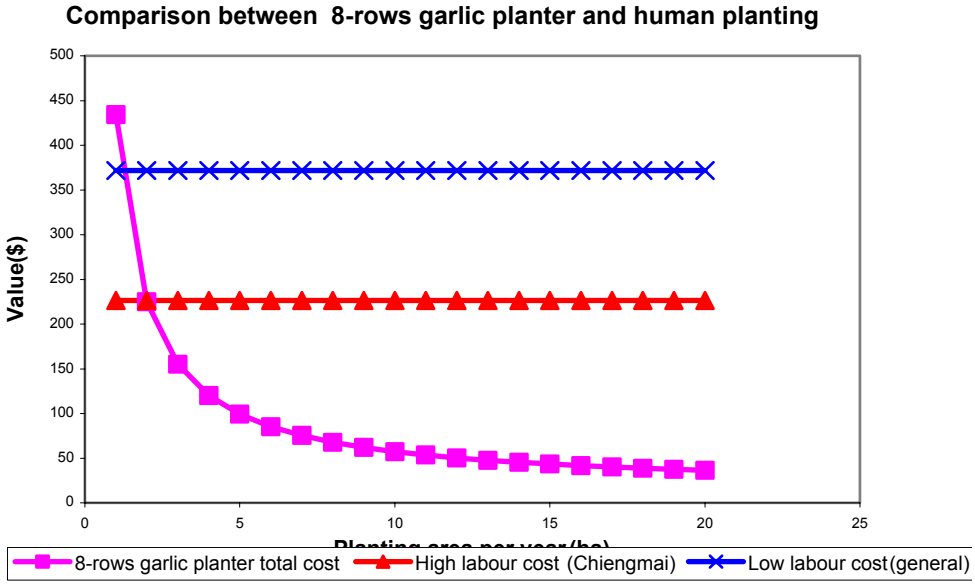



**Figure 7** consider beak even point that comparison the employment and the planter

Break even point analysis for comparison the cost for planting by farmer and 8 rows garlic planter showed that the planting area increasing farmer planting had the constant of fixed cost (per ha) as cost of planting by the planter had reduced the cost

**Table 7** Comparison of cost between employment and planter

| cost | cost($/ha) | | | |
|---|---|---|---|---|
| | Garlic planter | | human | |
| | quality | cost | quality | cost |
| 1.oil | 15.6 liter | 6.25 | - | - |
| 2.garlic | 850 kg | 637.5 | 625 kg | 468.75 |
| 3.employee | 1 person | 4.69 | 12-21 person | 226.56-371.88 |
| 4.tillage | 1 time | 78.12 | 1 time | 78.12 |
| | 2 time | 156.25 | | |
| | 3 time | 234.38 | | |
| 5.working time | 1 hour 12 minutes(1 person) | | 13hour 12 minutes (15 person ) | |
| total | 726.56-882.81 | | 773.43-918.75 | |

So that the conclusion of formality of the 8 rows garlic planter then

**Figure 8** the 8 rows garlic planter installed with 5 HP engine power tiller

**Specification of the 8 rows garlic planter**

| | | |
|---|---|---|
| Dimension (W×L×H) | 1300× 1600×1000 | mm. |
| Method of planting | single seed drill with cloves spacing,10 cm. | |
| Type of power | 5 HP engine power tiller | |
| Weight(included power tiller and engine) | 200 | kg |
| Volume of hopper | 15 | kg of garlic cloves |
| Type of metering system | bucket disk type | |
| Type of furrow opener | shoe type(V-shape furrow) | |
| Covering device | scraper | |
| Working width | 0.8 | m. |
| Working velocity | 1.68 | km/hr |
| Field capacity | 1.06-1.09 | ha/day |


**Figure 9** Compare planting by planter and planting by farmer

## Conclusion

1) The appropriate metering device is 6 plastic bucket disk metering device

2) Application of this metering device are use to change the bucket size for appropriate garlic size
3) The bucket shape was designed for single seed drill with cloves spacing,10 cm. and do not the garlic damage.
4) The planter installed on 5 hp power tiller and transmitting from driving wheel.
5) The appropriate working width is 0.8 m. have 8 rows.
6) The furrow opener is shoe type and Covering device is scraper type
7) Working velocity are 0.8-3.2 km./hr. as the same of metering unit revolution 20-60 rpm.
8) The average working velocity is 1.68 km/hr.
9) Field capacity is 1.08 ha/day

The next step of development are developed prototype for industry production should be the precision planter and convenient with installed to working and then carry to the farmer use the planter substitute employment

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