STATUS OF A FIELD CROP WEEDER IN THAILAND

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INTRODUCTION

In the annual planted area for field crop, there are major activities to improve production such as land preparation, weeding and fertilizer application, harvesting, cleaning, drying and storage. Each activity effects the increasing or decreasing of crop production. There is a suitable period for each activity which time of work for those activites directly effect to crop yield. The chemical fertilizer is widely used by farmers because it is very active to crop production. At present, weeder and fertilizer applicator are combined machine. The development of fertilizer applicator was modified from a field crop seeder which is widly used in farmer field. There is still a problem on a cultivater's blade which does not cut or destroy weeds properly. Weed can grow again. The problems of a fertilizer hopper and a fertilizer metering system being are corrosive by a granular fertilizer and clogging in a fertilizer metering system. These problems will caused a high variation of fertilizer rate and the difference of fertilizer rate between hoppers as well.

Keyword: Crop weeder , Fertilizer applicator, a pendulum blades

MATERIAL AND METHODS

1) Survey a weeder's manufacturer and farmers in Saraburi, Lopburi and Nakornsawan province which specialized on a fertilizer metering system.

2) Laboratory test: comparision of 5-type of fertilizer metering system which farmers have been using at present.

2.1) Fertilizer application rate of various revolution metering mechanism are 20, 30, 40, 50, 60, 70, 80, 90 and 110 rpm. The test was run at full and half fertilizer hopper level for each row of seeders and three repeatable.

2.2) Durability test for 40 hours was tested at 95 rpm(or tractor speed 5 km/hr). Fertilizer rate was checked and problems were recorded during test (RNAM, 1991).

3) Design and development on a power weeder with a fertilizer hopper are :

3.1) Design on a fertilizer metering system.

3.2) Design on a weeder's blade and a covering device.

3.3) Design and fabrication on a power weeder and a fertilizer hopper.

4) Practical field test

4.1) Tested and developed a prototype of a power weeder and a fertilizer metering system.

4.2) Tested on a furrow opener at various width of furrow.

4.3) Tested on variation of delivery rate.

RESULTS AND DISCUSSION

1) Survey of a weeder and a fertilizer hopper practice in farmer's field and manufactures as the following:

1.1) Three types of a weeder's blade were found in manufacture and farmer's field.

- Ridger type (Figure 1).
- Narrow wings type (Figure 2).
- Mouldboard type (Figure 3).

Figure 1: The 3-row ridgers weeder attached to tractor.

Figure 2: The narrow wings weeder attached to tractor.

Figure 3: A moldboard plough weeder attached to power tillers.

1.2) Initial testing was done with five types of a fertilizer metering system, a roller type (Figure 4),a plate type (Figure 5), a round screw (Figure 6), a flat screw (Figure 7) and a flute roller (Figure 8). These fertilizer metering system were widely used in farmers field.

Figure 4: A roller type

Figure 5: plate type

Figure 6:A round screw

Figure 7: A flat screw

Figure 8: A flute roller

2) Testing results of 5-types of fertilizer metering system.

Table 1 Fertilizer properties used in the test.

Properties	
- Density	763 kg/m^3
- Friction between a granular fertilizer and a steel plate	0.5
- Fertilizer diameter range	2.1 - 5.5 mm

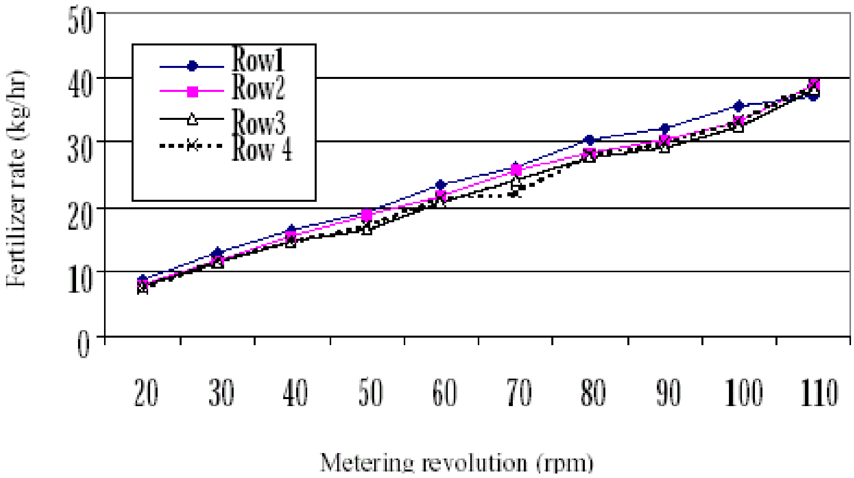
2.1) A roller metering system (Figure 9) For full hopper, increasing of fertilizer metering revoluation from 20 to 110 rpm raised up the fertilizer rate from 8 to 40 kg/hr. When the fertilizer in the hopper was full, the fertilizer rate would be increased uniformly. The tendency of fertilizer rate, at ½ hopper, was the same as full hopper but the seed rate was lower than about 2 percents.

2.2) A seed plate metering system (Figure 10) The fertilizer distribution of the 2-row seed plate metering system between 2 rows was different about 40 percents. The increasing of disk revolution from 20 to 80 rpm effected the fertilizer rate from 23 to 72 kg/hr. For seed rate revolution between 60-80 rpm, the fertilizer rate seemed to be constant. If seed plate revolution was higher than 80 rpm, it would cause problems of fertilizer by clogging in seed plate holes.

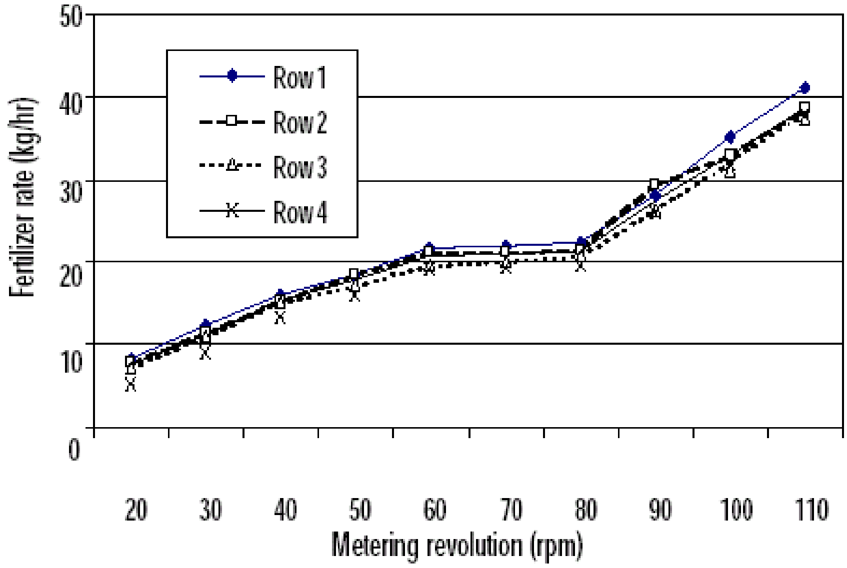
2.3) A round screw metering systems (Figure 11) The fertilizer distribution of the 2-row round screw metering system was less different in fertilizer rates. At screw revolution 20 to 110 rpm, the fertilizer rate have been changed uniformly from 40 to 220 kg/hr.

2.4) A flat screw metering systems (Figure 12) The fertilizer rate between 2 rows were performed well. The fertilizer rate of screw metering revolution from 20 to 110 rpm were raised up 50 to 240 kg/hr, respectively.

2.5) A flute roller metering system (Figure 13) The fertilizer rate at 50 rpm between 2 rows was uniform. The fertilizer rate was raised up when the metering system revolution increased from 46 to 250 kg/h. When the metering system revolutions were higher than 60 rpm, the fertilizer rates between 2 rows were different about 6-7 percent.



a) Full hopper



b) 1/2 hopper

Figure 9: Relationship between metering revolution and fertilizer rate of a roller metering type.

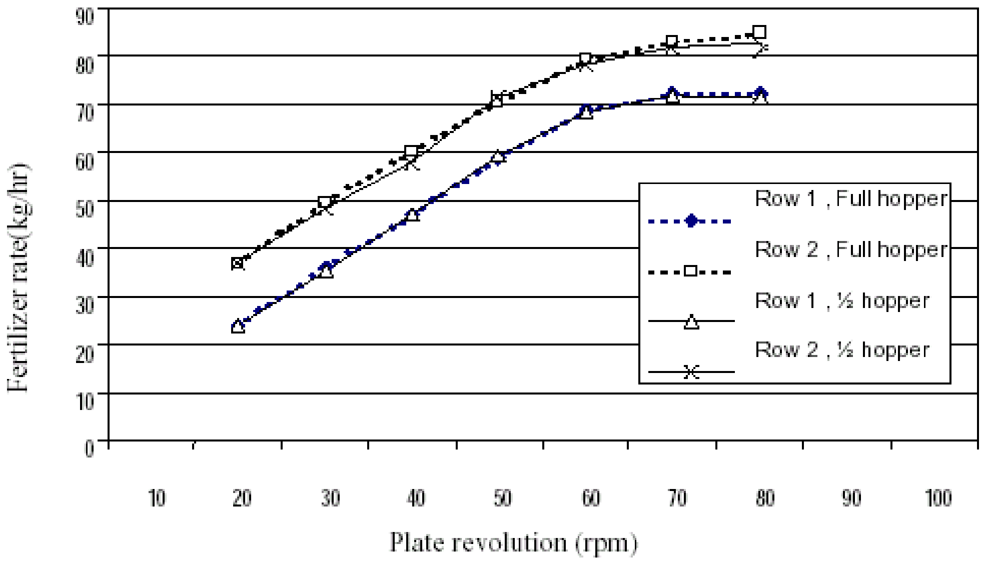


Figure 10: Relationship between plate revolution and fertilizer of a plate metering type.

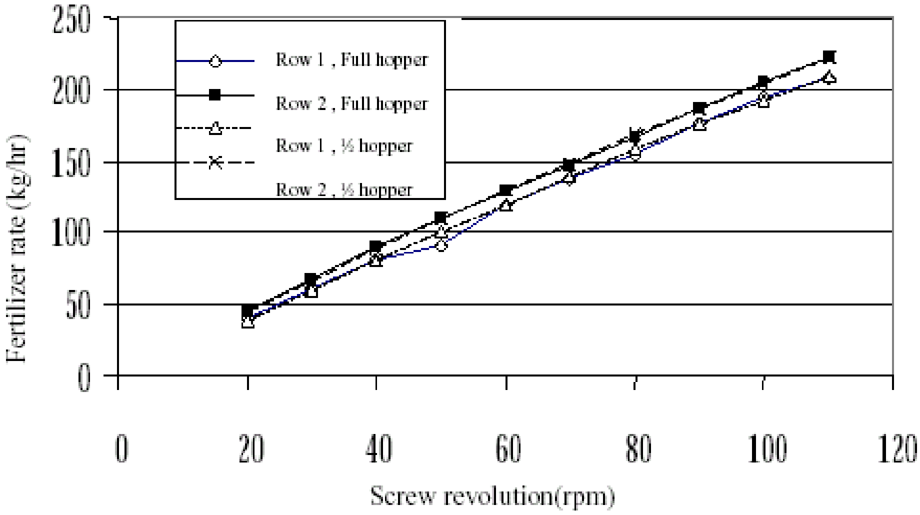


Figure 11: Relationship between screw revolution and fertilizer rate of a round screw metering type.

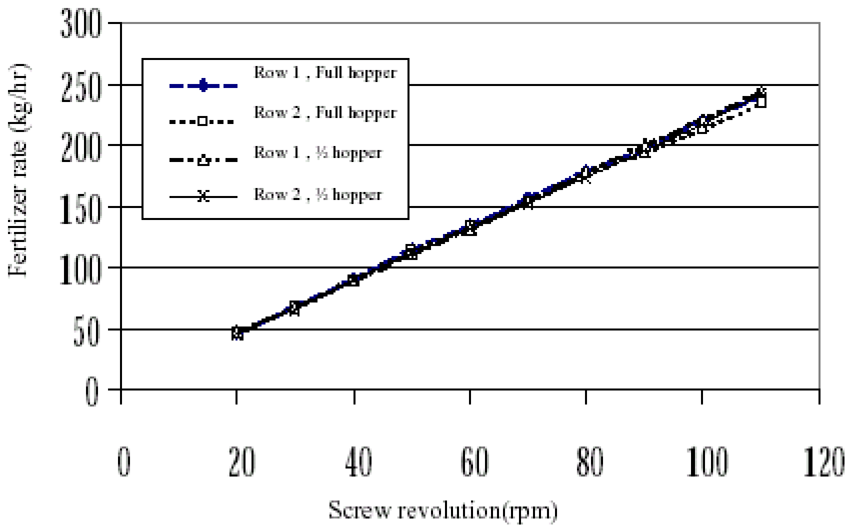


Figure 12: Relationship between screw revolution and fertilizer rate of a flat screw metering type.

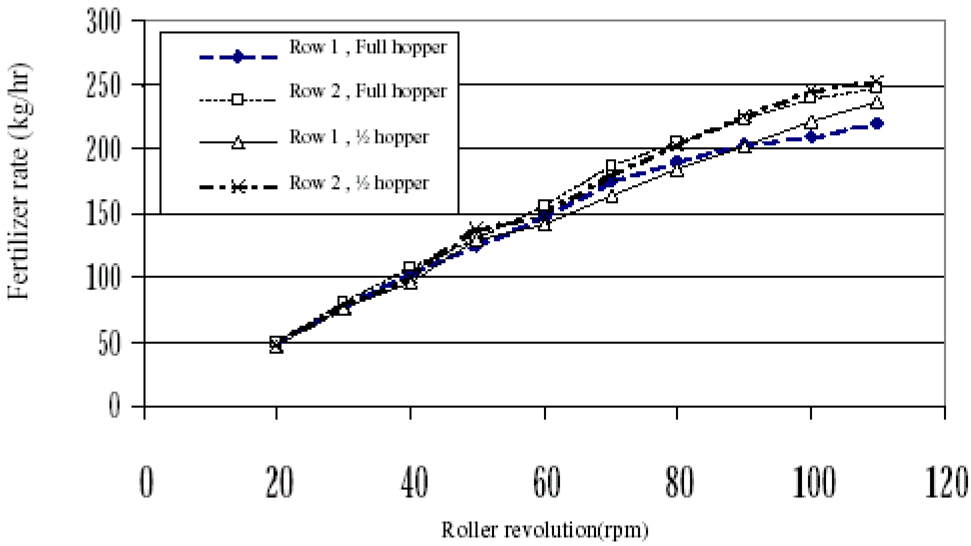


Figure 13: Relationship between roller revolution and fertilizer rate of a flute roller type.

3) Long run test for 40 hours : Long run test was tested at 95 metering system revolution (tractor forward speed 5 km/hr) for 40 hours in order to evaluate machine performance under real condition. The 4-type of fertilizer metering system were used as the following:- a roller type, a round screw type, a flat screw type and a flute roller type. For the plate type was not considered for this test because it cannot work at high revolution. The results of test for 40 hours for each type of fertilizer metering system were present on figure 14 to 17. the coefficient of variation (CV) for 4-types of fertilizer metering system were 4.6 to 17. The CV of roller type metering system was lowest about 4.9 and the highest CV was about 17.19 for the flute roller type.

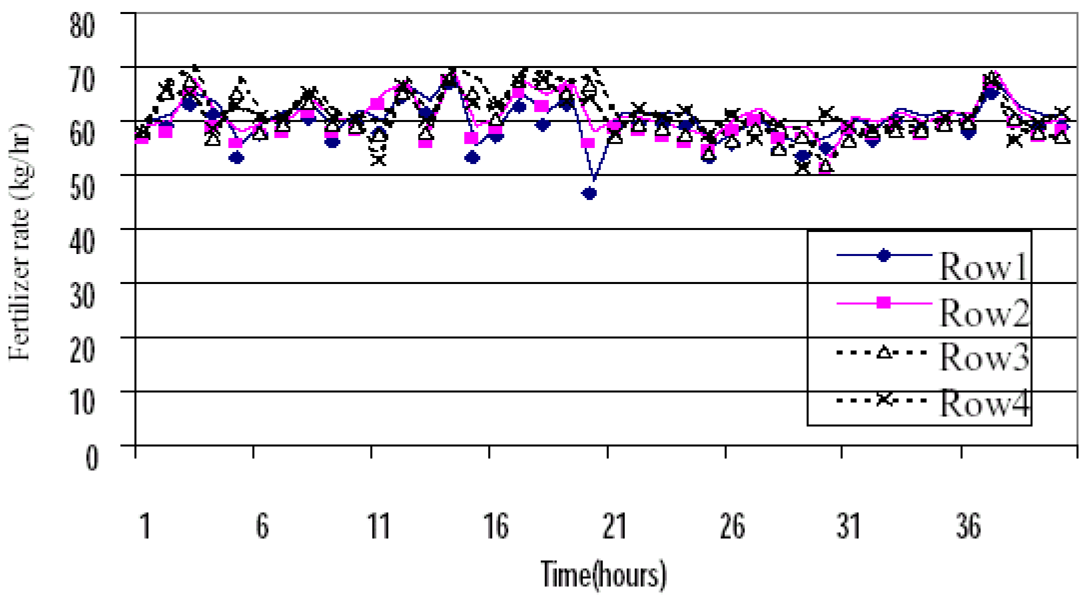


Figure 14: Relationship between fertilizer rate and serial time of a roller metering type tested at 95 rpm.

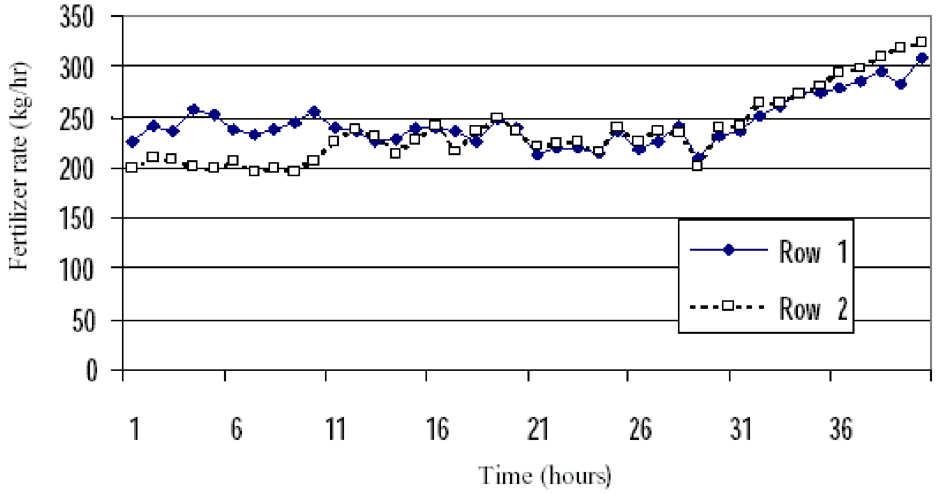


Figure 15: Relationship between fertilizer rate and serial time of the round screw metering type tested at 95 rpm.

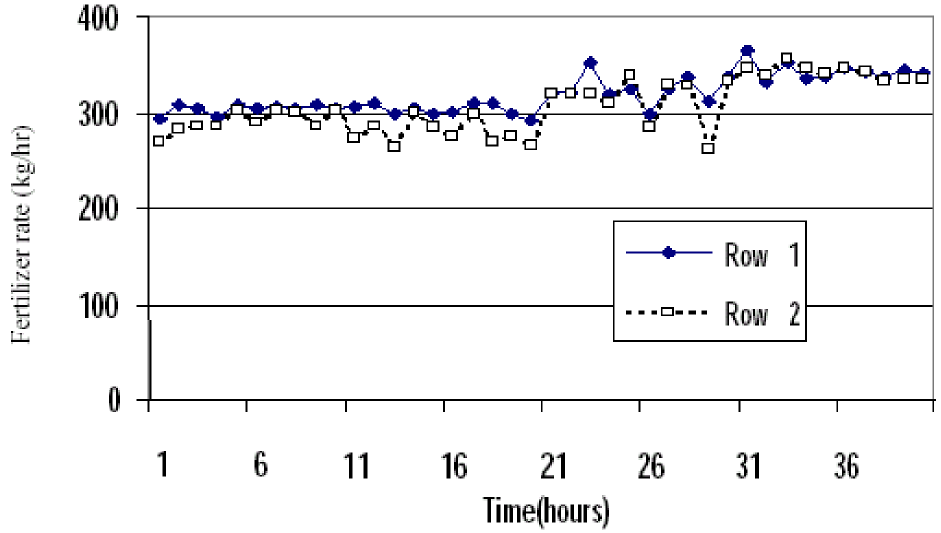


Figure 16: Relationship between fertilizer rate and serial time of the flat screw metering type tested at 95 rpm.

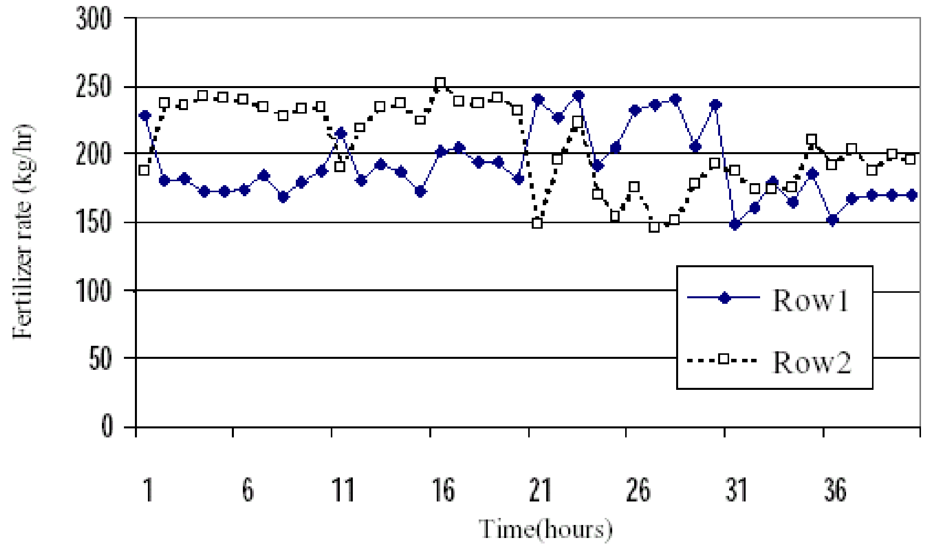


Figure 17: Relationship between fertilizer rate and serial time of the flute roller type tested at 95 rpm.

DESIGN AND FABRICATION OF A POWER WEEDER

The results of test were synthesized in order to construct a protoype of a power weeder attached to the tractor,18-25 hp. (figure 18).

1) Weeder's blades: Normally, the weeder's blades, using in the farmer field, can sweep soil and cut root. Some weeds fall down and continue growing later. Hence, the first prototype was constructed and tested, as shown in Figure 18. Test results were induced to the second prototype. The second prototype consisted of four sets of 24 cm pendulum blades in order to increase weeding efficiency. The pendulum blades width were driven by a 4-bar linkage and power take off (PTO) of the tractor at the induction speed ratio 1:1.92. The weeding amplitude and depth of working were 61 cm and 5 cm, respectively. The vibrating frequency was between 5.4-8.7 Hz.

2) Fertilizer hopper: The first prototype, a fertilizer hopper (figure 18), was made of steel sheet with the wall inclined 23 degree from vertical. The capacity of fertilizer hopper was 0.0374 m3 with 28 kg fertilizer capacity. The second prototype, a fertilizer hopper, was made of a plastic sheet for corrosive prevention with wall inclined 42 degree from vertical (as shown in figure 21). The hopper volume was 0.0696 m3 with 53 kg fertilizer capacity.

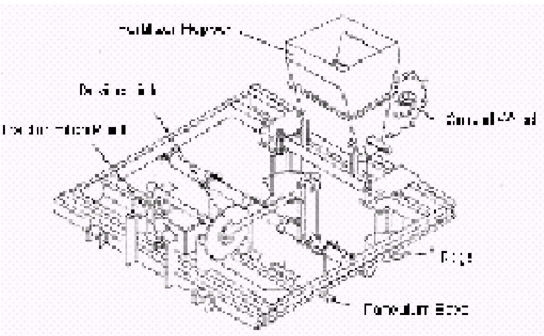


Figure 18: The first prototype : a power weeder.

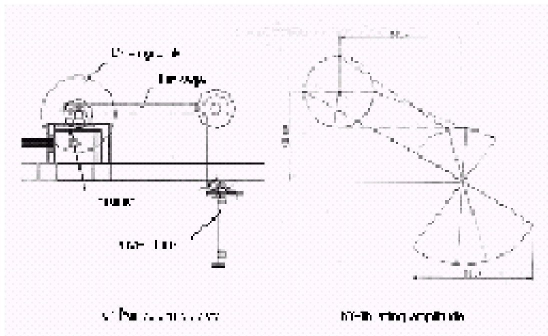


Figure 19: Design of pendulum blades for the first prototype.

Figure 20: Field test of the power weeder at King Mongkut Institute of Technology Ladkrabang.

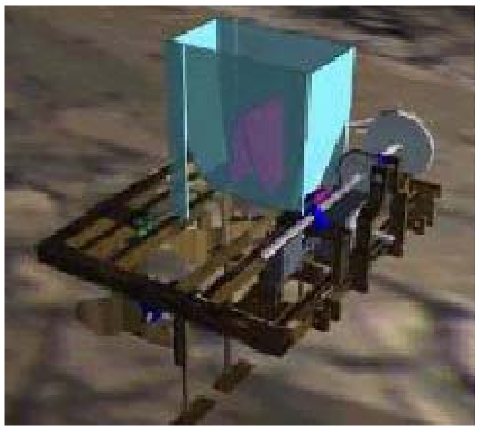


Figure 21: The second prototype of a power weeder.

3) Fertilizer metering system: Fertilizer metering device was a plastic screw, 2-way discharge, with 5 mm screw height and 400 mm screw pitch. Fertilizer metering device was driven by PTO.

4) Fertilizer tube: The maximum rectangular discharge length, not caused fertilizer clogging, was 7.5-160 mm (Bernachi, 1972). The plastic tube was used with diameter 25 mm and length 50 cm.

5) Ridger and covering device: Two ridgers were attached for covering fertilizer and made furrow at 50-70 spacings. Ridger wings were adjustable at 22-44 cm.

CONCLUSIONS

1) Field evaluation of the weeder's blade should be designed in order to change blades. It is suitable for crop and field conditions.

2) The fertilizer metering system should be adjusted in order to achive high performance of fertilizer rate.

3) Covering device should be designed only one type. Ridger is not work well under slope areas.

4) High vibrating frequency can destroy weed better than low vibrating frequency.

5) The promising field areas should not have stone, wood or any obstacle under the field. These will caused the problems on breaking weeder's blade.

REFERENCES

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2. RNAM. 1991. **Agricultural Machinery Design and Data Handbook** (Seeders and Planters).