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VI- SUMMARY AND CONCLUSION

The centrifugal distributor is rapidly becoming the most widely used machine for the spread of fertilizer. This type of mechanism has the advantages of low cost, simplicity of operation, ease of cleaning and relatively small size for a given width of spread. But it is least accurate in holding to a desired rate for three reasons: the first is that the variable orifice is not a positive displacement-metering device. The second is that, since the metering unit dose not has positive displacement, the metering rate is not linked to the travel speed of the spread. The third is that the swath width of the broadcasting is not as precisely determined.

The main purpose of this study is to develop a locally spreader to spread the different materials of fertilizer with rates can be automatically controlled. For this reason an electronic circuit has been constructed to control the feed rate of fretizer with respect to forward speed of the machine. The spreader prototype was operated using the power unit of the prime mover of Yanmar ARP-8 Rice Transplanter to meet the demands of small and medium farmer in Egypt. On the other hand, the use of the rice transplanter as a source of power could be considered as a mean to intensify the use of farm machnery.

Modification of prototype of the machine and the preliminary tests were carried out at Rice Mechanization Center (RMC) workshop, Meet El-Deyba, Kafr El-Sheikh, Agricultural Engineering Research Institute.

The Yanmar ARP-8 rice transplanter was used as a power unit after separation of the transplanting section. The spreader unit was mounted in the same hitch point of planting section of rice transplanter.

The field experiments were carried out during 2002 and 2003 wheat growing season in an area of 6 feddans at the research farm of Rice Mechanization Center (RMC), Meet El-Deyba, Kafr El-Sheikh, Agricultural Engineering Research Institute.

Scope of Variables:

a- Experimental tests under controled conditions:

* IT were carried out on two stages, the first one was to evaluate the effect of the following factors on the distribution pattern of spreader:

1. Two types of spinner plate namely; cone and flat types of spinner plate.

2. Two numbers of spinner blades on the plate; 4 and 6 blades.

3. Four levels of rotational spinner speed; 360, 480, 600 and 750 rpm.

4.Two types of fertilizer, namely; powder (super phosphate) and granular (ammonium nitrate)

* The second group of tests were done under the optimum values obtained from the first group tests to focus the effect of the following factors on the distribution pattern.

1. Two different spinner diameters; 200 and 300 mm

2. Four levels of feeding rate; 100, 150, 200 and 250 kg/feddan.

3. Three blade angles; -10, 0 and +10 degree

4.Three types of fertilizer; the same two types used in the first group of tests and coarse urea fertilizer.

b- Field experiments:

To evaluate the modified spreader under field conditions during fertilization of wheat crop comparing with common centrifugal spreader (traditional), a series of field experiments were carried out for each spreader. The following variables were introduced in this study:

1.Three different forward speeds; 1.39, 1.95 and 2.9 km/h for the modified spreader and 1.90, 2.85 and 3.70 km/h for the traditional spreader.

2.Four different spinner speeds; 360, 480, 600 and 720 rpm for the both types of spreader.

Measurements

♦ In case of laboratory tests the following parameters were determined:

1. Coefficients of variation and uniformity.

2. Percentages of maximum and minimum points of the mean in the distribution pattern

♦ Coefficient of symmetry (pattern skewing)

♦ While, in case of field experiments the following measurements were taken under consideration:

1- Measurements on the crop:

1- Number of spikes per square meter

2- Total grain and straw yield

2- Measurements on the machine

1- Fuel and power consumption

2- Field capacity and efficiency.

3- Slip ratio.

Conclusion:

The following conclusion were drawn based on the results obtained from the present study:

I- Experiments tests under controled conditions:

1- Spinner rotational speed:

♦ The lowest values of coefficient of variation and percentage of maximum point were obtained at 600 rpm flat spinner speed and 480 rpm cone spinner speed.

♦ However, they gave highest values of percentage of minimum point and coefficients of symmetry and uniformity for both types of fertilizer and number of blades. Hence the best distribution pattern were obtained with 600 rpm for flat spinner and 480 rpm for cone spinner compared with other spinner speeds.

2- Number of blades:

♦ The coefficient of variation increased by 2.86 and 4.63% and the maximum point increased by 3.79 and 7.25% when the number of blades increased from 4 to 6 blades for granular and powder fertilizer respectively.

♦ While, the coefficient of symmetry decreased by 2.87 and 1.35% and the coefficient of uniformity decreased by 1.71 and 3.4% at spinner speed of 720 rpm.

3- Spinner type:

♦ At all spinner speeds and for both number of blades, the flat spinner gave the best distribution pattern than cone spinner.

♦ The coefficient of variation of 28.31%, coefficient of uniformity of 71.69% and the coefficient of symmetry of 96.94% were obtained with flat spinner compared with 34.73, 65.27 and 92.11% for cone spinner respectively at blade number of 4 blades and spinner speed of 600 rpm.

4- Feed rate:

♦ The feed rate of 150 kg/fed gave the best distribution pattern for granular and powder fertilizers. But for coarse fertilizer, the feed rate of 100 kg/fed gave optimum distribution pattern compared with the other feed rates at all blade angles and spinner diameters. Increasing feed rate to 250 kg/fed caused worsen distribution pattern.

♦ The highest values of coefficient of uniformity and symmetry of 37.86 and 96.63% were obtained at feed rate of 150 kg/fed for granular fertilizer. While the lowest values of variation coefficient of 25.97 and maximum point of 158.78 were obtained at feed rate of 100kg/fed for coarse urea with blade angle of –10 degree and spinner diameter of 30 cm.

5- Blade angle:

♦ The highest values of uniformity and symmetry coefficients and percentage of minimum points of the mean were obtained at blade angle –10 degree when using coarse and powder fertilizer, hence it gave minimum values of coefficient of variation and maximum point. In case granular fertilizer, blade angle of 0 degree (radial) gave the best distribution pattern when using blade angle of +10 degree the distribution pattern becomes worse.

6- Spinner diameter:

♦ When using spinner diameter of 20 cm instead of spinner diameter of 30 cm, the coefficient of variation increased by 14.42% and maximum increased by 4.85%. But the coefficient of uniformity decreased by 5.48% and minimum point decreased by 12.66% at feed rate of 100 kg/fed, blade angle of 0 degree and urea fertilizer. Therefore, the spinner diameter of 30.cm gave the best distribution pattern than diameter of 20 cm at all feed rates, blade angles and fertilizer types.

II- Field experiments

1- No. of spikes/m^2 , grain and straw yields:

1-1 Spinner speed:

♦ The highest values of No. of spikes/m^2, hence grain and straw yield were obtained at spinner speed of 600 rpm for both types of spreader. It gives maximum values of 18.10 ardab/fed grain yield and 2.10 ton/fed straw yield for modified spreader at forword speed of 1.39 km/h .

1-2 Forward speed

♦ Increasing the modified spreader forward speed from 1.39 to 2.90 km/h the grain yield decreased by 12.93 and the straw yield decreased by 20.64 % at spinner speed of 600 rpm.

♦ When using traditional spreader, increasing the forward speed from 1.85 to 3.70 the grain yield decreased by 16.13 and straw yield decreased by 23.18% at the same conditions.

1-3 Spreader type:

♦ When using modified spreader instead of traditional spreader, the components of yield hence grain and straw yield increased.

♦ The maximum values of 18.10 % ardab/fed grain yield and 3.10 ton/fed straw yield were obtained with modified spreader compared with 15.05 ardab/fed and 2.76 ton/fed for traditional spreader.

2- Field capacity and efficiency:

♦ By increasing forward speed the field capacity increased while the field efficiency decreased.

♦ At all forward speeds and fertilizer type, increasing spinner speed tends to increase field capacity. But it had a little effect on field efficiency.

♦ By using granular fertilizer instead of coarse fertilizer. The field capacity increased. While, powder fertilizer gave the lowest values of field capacity and efficiency compared with other types.

3- Fuel consumption:

♦ Increasing forward speed tends to increase the rate of fuel consumption and specific fuel consumption in l/kW.h while the fuel consumption in l/fed was decreased.

♦ The highest values of fuel consumption in l/fed were obtained with spinner speed of 360 rpm. But the lowest values were obtained with 720 rpm.

♦ When using granular fertilizer, the fuel consumption in l/fed was found to be 0.62 l/fed compared with 0.89 and 2.3 l/fed for coarse and powder fertilizer, respectively at spinner speed of 480 rpm and forward speed of 2.9 km/h.

4- Energy requirement:

- By increasing forward seed the energy requirement in kW.h/fed decreased.
- Increasing spinner speed tends to decrease energy requirement in kW.h/fed at all factors used.
- The highest values of energy requirement in kW.h/fed were obtained with powder fertilizer, but the lowest values were obtained with granular fertilizer at all forward and spinner speeds.

5- Slip ratio:

- By increasing forward seed the slip ratio increased.
- The highest value of slip ratio of 4.65 % was obtained with powder fertilizer. While the lowest value of slip ratio of 4.13 % were obtained with coarse urea at forwad speed of 2.9 km/h.

III- Fertilizer Application Cost:

The total cost for fertilizer distribution operation were found to be 6.19LE/fed when using ammonium nitrate. However it were 8.48 LE/fed when using coarse urea and 11.97 LE/fed when using super phosphate at forward speed of 2.90 km/h and spinner speed of 600 rpm.