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EVALUATION OF FUNCTIONAL PARAMETERS OF DIFFERENT PLANTERS WITH THE VARIABLE AMOUNT OF WHEAT SEED DENSITY

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ABSTRACT

Wheat is one of the most important strategic products in Iran that has proposed a cultivation area equal to 6.2 million hectares. Now, wheat planting is very important due to various planting machineries such as different types of drill planting, combination sowing, and centrifuge sowing and they need to be investigated technically and economically. This study used a split-plot design. The main planting plot treatments include:

1 .Taka drill planting

2. Hamedani drill planting

3. Hassia drill planting

4.The conventional methods (sowing by hand or centrifuge + disk + Leveler) were done in 4 replications. Besides, the sub land includes seeding densities of 120, 180 and 240 kg per hectare. After plowing, all the treatments were fertilized in depth of 25 cm and then the disk was fertilized. Then, the factors related to field capacity, the time required to perform the operation, fuel, plant density in level unit, yield and yield components, uniformity of seed distribution horizontally and vertically, green percentage and soil cone index were measured. The data were statistically analyzed. The yields showed no significant difference between 180 and 240 kg/ha treatments in different planting methods. However, despite of a significant decrease of the yield

in 120 kg, a significant difference was observed in the centrifuge sowing treatment, so in this method seed rate reduction is not recommended.

Keywords: Planter, driller, sowing

INTRODUCTION

Different methods of planting may have no effect on yield, however, due to use of different machines in different ways, the disturbance of the soil structure, the required time for the operation of planting, energy and the consumed seed and finally the resulted cost will be different in each method which necessitate theses methods to be evaluated regarding different factors. On the other hand, since the manufacturers of agricultural machinery had offered new designs of seed planters, their efficiency should be investigated in different regions in different conditions. The aim of this project was to evaluate the technical and economic aspects of conventional planting machines and to determine their strengths and weaknesses and to discover the essential density for mechanized cultivation of wheat.

Afzalinya *et al* (1999) examined the effect of planting methods on yield of water wheat and compared the methods economically and they concluded that in terms of yield, although there was no significant difference between treatments, the treatment of planting with drill planting of grain and basin irrigating has the highest yield. Economic comparison of treatments showed that the above treatment not only has a higher yield, but also it is less expensive [2].

Afazlinya *et al* (1999) investigated the common drill planting in Zarghan, Fars province, Iran. The results showed that the treatments difference in regard of uniformity of seed distribution, plant density in unit of level and yield is not significant. Hassya drill planting benefits from the best effective density of the field and Keshtgostar drill planting has the highest field efficiency. In general, the overall yield index of drill planting showed that Hamedan drill planting machine was the best planter and Hassya, Keshtgostar and Nerdeston (Denmark) are located in the second row. Danish drill planting possessed the best economic yield [3].

Javadi *et al* (2003) studied two planter machines including a drill planting and a row planting through hand sowing traditional methods in 3 levels of seed densities for mechanization of Chickpea cultivation.After determining different factors such as uniformity of planting depth, evenness of distances between shrubs, shrub height and yield performance, they concluded that drill planter in seed density of 75 kg per ha has an acceptable yield for mechanized planting.

Afazlinya *et al* (1999) investigated two common row planters (Techno Huck and Snowbell) in Fars province in terms of different factors such as accuracy of the depth of planting, maintaining suitable longitudinal distance between seeds on the rows, lateral distribution of seeds and etc.The results showed that there is no significant difference between two types of row planters in case of depth of planting in the field and seed fracture percentage in the laboratory, however, lateral distribution of seeds and seed fracture percentage in the field were significantly different. In general, according to most comparisons, Techno Huck row planter works better [1].

Tachy (1996) compared four wheat planting methods with three values of seed in per hectare. The results showed that the combination method distributes the seeds with better uniformity in horizontal levels when it is compared with drill planter performance. However, in this method, the distribution of the seed in depth is more than drill planting. In mixed planting method, uniformity of the horizontal distribution is not different with drill planting and distribution of seeds in depth in this method was higher than any other treatments. Mean weight diameter of clod and four times of disk passing at the time of land production was not different with combination method. The soil compaction in combination method in spite of using heavy tractor is less than using disk in four times. There was no difference between treatments in terms of yield performance. The total used time in combination method was 76% and consumed fuel was 53% less than drill planting after crossing disk in four times [4].

Dryden (1969) compared different methods of wheat planting in stubble field and sandy loam soils on yield of protein content and specific weight of wheat, and he concluded that stubble field cultivated with direct seeding and using disk after planting has a better yield, however, in sandy and loamy soils, planting with drill planter equipped with single disk furrow opener has a better yield [7].

Heege (1993) compared several different methods of planting cereals, seeds of vegetables and legumes. Planting methods include: 1. Drill planting by using drill planter 2-band planting 3. Overall planting (distributive) 4 .precise drill planting (controlled regarding planting depth and overall method(distributive) benefit from the best seed distribution per unit area [8].

Peruzzi & *et al* (1996) compared different methods of tillage including conventional tillage, low tillage and no tillage in planting wheat and corn. In low-tillage method a complex machine was used in which tillage operation with once traffic was done. The results showed that the required time to perform low tillage and no tillage systems was on average 80% less than conventional tillage. Besides, the amount of consumed fuel, the required energy and energy efficiency in both no-tillage and especially low-tillage, is less than the conventional tillage methods.Overall, economically; while the low-tillage and no-tillage systems have slightly decreased the yield performance, but gross profit increased compared with conventional tillage or at least it remains constant [9].

Senapati *et al* (1992) compared the yield of 5 types of drill planters. In this study, 11 important factors in drill planters were considered as comparison criteria. These factors were: the force required to pull the drill planters, field efficiency, field capacity, uniformity in distribution of seeds, plant density per ha, operating costs per ha, planting depth, adjustable row spacing, number of workers applying to work with drill planter, yield yield and simultaneous distribution of fertilizer and seed. After evaluating these factors and considering the effect of each factor on the yield of drill planter and by using general yield indicator, the general results of each drill planter were calculated and compared. Final results showed that the combined drill planter (with fertilizer and seeds tank) in Gujarat province has the best yield and it is the best drill planter for the RCA India [10].

METHODOLOGY

In this project, first, the irrigated land and moldboard plowing operations (in conventional method) were performed. Then, the secondary tillage treatments were administered. The used seed was plateau. All agricultural operations (except experimental treatments) such as land preparation, fertilizer application, spraying and etc were done in the same plots. The used land was for planting wheat, and the residue was poured out from behind the combine and other remains kept intact and were buried by plowing.

Split-plot design was used in this study. Main plot of planting treatments were: 1 Taka drill planting 2. Hamadani drill planting 3. Hasya drill planting 4. Conventional methods (seeding by hand or using a centrifuge + disk + leveler) in 4 replications. Besides, the subsidiary plot includes different levels of seed density such as 120, 180 and 240 kg per hectare.

Measured factors and measuring method are

1. **Field efficiency:**

To calculate the field efficiency, a farm land with an area of 1.5 hectares was chosen, and planting operation was carried out using special seed planters.In this area, the beneficial and non-beneficial times were measured using working around and making the tanks full through field efficiency equation for each seed planer.

$$e = \frac{T0}{Tt} \times 100$$

Where e is field efficiency

T_0 beneficial time

T_t= total spent time

Field capacity:

By measuring working speed and width and by using the following formula, the field capacity was calculated:

$C_e = \frac{w.s.e}{10}$

Where

C_e = effective field capacity ha.h

W =width of the machine in meters

S = working speed in kilometers per hour e = efficiency of field

e= field efficiency

Consumed fuel:

In order to measure the consumed fuel, the full tank method was used. The tank of tractor is made full before planting and seeding in a certain level, the amount of consumed gasoline was calculated for that level and therefore in hectare.

Yield performance:

By eliminating the margin of each plot, the crop in each plot is harvested by combine and by weighting the grains the yield yield in each hectare was obtained.

The mean weight diameter (MWD)

Chopped clods of soil were evaluated based on mean weight or sola aggregate diameter by a series of four sieves. The sieve has square apertures in side length of 2, 1.5, 1 and 0.5 inches. The soil in 30 cm length, and the width and depth of cluttered soil was collected and passed through the sieves. The amount of remaining soil was weighted on the greatest sieve is weighed and the mean diameter of the clot was measured in three dimensions. The mean weighted diameter of aggregates is calculated using the following formula. (Note that this parameter (MWD) was measured only after the tillage operation in the plots and before plowing it is not measurable)

$$MWD = \frac{W_1 \times D_1 + ... + W_5 \times D_5}{W_1 + W_2 + ... + W_5}$$

Where:

W_1 ... .W_5: weight of the soil on 1 to 4 sieves and the soil weight placed on the ground

D_1 ....D_5: 1 to 4 sieve diameter and the diameter of the clots on the first sieve

MWD measurement is done at three points in each plot.

The uniformity of horizontal distribution of seeds:

In order to measure the horizontal distribution of seeds, a box with dimensions of 0.5 to 1 m was used. By putting the box in 3 points, randomly in each plot and measuring the distance of each bush plant to the nearest adjacent bush by using Snapaty formula (10) the coefficient of horizontal uniformity of seed distribution was calculated. Snapaty formula is as follows:

$$S_e = 100(1 - \frac{Y}{D})$$

Where:

S_e = coefficient of uniformity of seed distribution

Y = mean absolute difference from the total mean

D = the mean of obtained distances

The uniformity of vertical distribution of seed (seed placement depth):

After planting and seed germination in all 20 points of each plot, some plants were randomly removed and the planting depth from the seed location to that part of the stem which is not green in the absence of light was measured. Using the Snapaty formula, as it was mentioned in the horizontal distribution of seeds, the uniformity of seed vertical distribution was calculated.

Green percentage of the plant:

Since the amount of planted seed is known. By weighting 1000 seeds, the number of planted seeds in per unit area is determined.So by placing a square box with dimensions of 1 x 1 m and counting green plants in three random points and by using following formula, the field green percentage was calculated:

$$E = \frac{P}{S} \times 100$$

Where:

E = the percentage of green plant

P = number of green plants

S = the number of planted seeds

Soil cone index:

After the first planting and irrigation by using a cone penetrometer and one after month, penetration resistance at 10 points in each plot to a depth of 30 cm was performed with the measured moisture.

DISCUSSION AND CONCLUSION

Efficiency and field capacity

The first year project results revealed seeding superiority with centrifuge compared to other treatments. It should be mentioned that all machines used one operator. Field dimensions were 120 x 100 meters and row length was 120 meter.

Uniformity of vertical and horizontal distribution:

Using the Snapaty formula, the uniformity of vertical and horizontal distribution of seeds was determined.

In the measurement of each machine replication three levels of 120, 180 and 240 kg seed in hectare of a sample were harvested. The results showed no significant difference between drill planting treatments in terms of horizontal distribution of seeds, but seeding with centrifuge didn't show a better horizontal dispersion than two first types so it was placed in lower classes. Hamadani planter for vertical distribution of the seed had the best condition, and then Takai and Hassya were placed. It seems that this is due to using furrower after planting for watering. Seeding with a centrifuge was done for the same reasons and because of using the disk after planting, planting depth had the lowest uniformity.

The results showed that the use of drill planters cannot lead to a significant reduction in the aggregate diameter. However, in the conventional method, since disks have been used, the aggregate diameter was reduced.

The results showed that Hamadani drill planter at all levels of seed had a higher green percentage. This is more affected by distribution of planting depth uniformity which was discussed previously.

Since the planting date was somehow late, the low seed density (120 kg.ha) faced with yield losses and they were encountered in the lower classes. Among different drill planters, Hamadani planter showed the highest yield at a seed rate of 240 kg. performances showed no significant difference between treatments of 180 and 240 kg per hectare. However, a significant decrease was shown in the yield of 120 kg, and a significant difference was observed in seeding treatment centrifuge. Therefore, in this method it is not recommended to reduce the amount of seed.

Table 1: Effect of types of drill planter on field capacity and efficiency

Treatment	Field capacity (ha.hr)	Field efficiency (%)
Hamadan drill planter	^{b}0.85	^{b}0.63
Taka drill planter	^{b}0.97	^{b}0.65
Hassia drill planter	^{b}0.95	^{b}0.61
Seeding with centrifugal disc	^{a}2.1	^{a}0.81

Table 2: Effect of planter type on horizontal and vertical distribution of seeds

	Horizontal distribution	Vertical distribution
Hamadan drill planter	91.82	26.51
Taka drill planter	2.76	3.58
Hassia drill planter	17.75	62.18
Seeding with centrifugal disc	13.28	82.39

Table 3: Evaluation of the effect of different planters on the mean weighted diameter

	MWD
Hamadan drill planter	36
Taka drill planter	33
Hassia drill planter	32
Seeding with centrifugal disc	1

Table 4: Effect of the planter type on mean percentage of green plant and plant performance

Planter type	Seed density	Green plant percentage	Yield (kg.hr)
Hamedani drill planter	120	[a]61	[b]3720
Hamedani drill planter	180	[a]62	[a]4363
Hamedani drill planter	240	[a]64	[a]4592
Taka drill planter	120	[b]56	[c]3631
Taka drill planter	180	[b]57	[a]4265
Taka drill planter	240	[b]57	[a]4529
Hassia drill planter	120	[b]55	[c]3524
Hassia drill planter	180	[b]56	[a]4137
Hassia drill planter	240	[b]56	[a]4350
Seeding with centrifuge and disc	120	[c]50	[d]3121
Seeding with centrifuge and disc	180	[c]49	[b]4014
Seeding with centrifuge and disc	240	[c]51	[a]4398

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