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Comparison of Performance Planting Methods on Ridge and Conventional Soybean Cultivated Under Dry and Wet Seedbed Condition in North-West Iran

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Abstract: In order to evaluate different planters for mechanized soybean cultivated in two ways under dry and wet seedbed condition planting. This study was conducted using a randomized complete block design with six treatments and four replications. The experiment took place in two years from 2011 to 2012 at the Agricultural Research Center in Ardabil province (Moghan). The planter types were consisted of cereal deep seed drills (John Deere) under wet seedbed condition with 25 and 50 cm in row spacing as the first and second treatments, T1 and T2, respectively (conventional methods), grain drills from Barzagar Hamadan with 25 and 50 cm in row spacing as third and fourth treatments, T3 and T4, respectively and Gaspardo pneumatic row planters with 50 cm in row spacing as the fifth treatment, T5 and Node two-row ridge planter with 75 cm in row spacing as the sixth treatment, T6. The evaluation results of machine types showed that there was significant difference between the machine type and other performance parameters. Results indicated that use of T6 and T4 led to highest and lowest yields with 2864 and 2252 kg ha^{-1}, respectively. Planter type and cropping pattern also had significant effects on germination at 1% probability level. Pneumatic ridge planter had maximum percentage of seed germination (87.32%). Coefficients of seed distribution were found to be the highest for pneumatic ridge planter in adjusted distances (83.04%) and in averaged distances (87.32%). Therefore, considering many factors, the pneumatic ridge planters tested in this study was found to be the best suited planter and therefore is recommended for soybean planting in the region.

Key words: Planter type · Planting pattern · Soybean · Evaluation · Yield

INTRODUCTION

Moghan Plain in the north province of Ardebil, is considered as important areas of soybean planting in the country. Soybean cultivation for the first time begin with establishment seed oil company at Moghan plain in 1971. The first seeds of cultured has been related to Imported (from foreign countries) Williams varieties. Around the Bilesuar city, Babak and eastern regions of Pasrabad and Jafarabad is the most major soybean cropping regions in the Moghan plain. In 2002, the area under soybean cultivation in Moghan plain about five thousand hectare (ha) and in 2003, over 6000 ha [1]. And this trend is increasing so that in the cropping season 2006-2007 get to 10962 ha with a total yield of 25 Mt ha^{-1} and the mean yield of the region has reached 2,591 kg ha^{-1} [2] and in the cropping season 2000-2001 has more than 13,000 ha. According to increase of area under cultivation and food value of soybean product in the country, every year a wide level of Moghan plain is devoted to soybean cultivation and more than 95% of the surface, second crop (summery) cultivated and Farmers in the Bilesuar region, mostly using deep seed drills (John Deere) with different planting density and in the central part of Parsabad Moghan of Grain drill (Barzagar Hamadan) and row planter for sowing soybean. Therefore, different methods of planting possible that have many effects on soybean yield. On the other hand, using of different methods cropping with variety machines causes to corrosion rate of soil structure, time required for planting operations, seed and consumer energy and finally, the costs vary in each different method and this difference will require to these methods in terms of various factors evaluated. On the other hand, according to various regional conditions, there must be efficacy of different soybean planting machine evaluated. A review of past research

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this subject shows that in each area should be applied appropriate planting method for different products of area or climate. Soybean in Moghan plain cultivated in two ways under dry and wet seedbed condition planting but planting method and machine in Bilesuar region is different in comparison with Parsabad regions. With this purpose the evaluation of soybean planting machine with different planting pattern was considered. Soybean in Moghan region is cultivated by grain drills and other planter with different seed rate related to seed varieties between 90-100 kg ha^{-1} and deep seeding 3-5 cm that yield soybean has a strong dependence to row spacing [1].

In the study Afzali Nia [3] assessed performance of common grain drills in Iran in Zarghan area in Fars Province. Results of the study showed that differences between treatments in terms of seed distribution uniformity factor, plant population per unit area and yield product is not significant. John Deere grain drill has best effective field capacity and Kesht Ghostar grain drill have highest field efficiency. In general, an overall performance index grain drill indicated that grain drills from Barzagar Hamadan machine is the best grain drill and John Deere grain drill, Kesht Ghostar and Nrdstvn (Danish) located in new row. Danish grain drill has the best economic performance [4].

In the study Javadi *et al*. [5] investigated two planter machine includes a grain drill and a row planter with the traditional method of hand-spraying in 3 levels of seed density for mechanizing pea dry cropping. After determining the various factors, such as uniformity of planting depth, uniformity distance between plants, plant height and yield concluded that grain drill has acceptable yield in the 75 kg/ha, for mechanized planting. Also, Afzali Nia [3] assessed performance of two types of common row planter (tecno hak and sanabel) on various factors, such as precision in depth planting, Provide appropriate longitudinal distance between seeds in on planted row and lateral distribution of seeds. Results showed that between two types of row planter in planting depth in field and percentage of fractures seed in the laboratory there are no significant differences but lateral distribution of seeds and percentage of fractures seed in the field have a significant difference together. In most of the factors comparison, Techno Hak row planter has a better yield [3]. In the study Senapati *et al.* [6] compared the performance 5 types grain drill and 11 important factor in grain drill as the comparative criteria were considered. These factors was included force required for pulling grain drill, field efficiency, field capacity, uniformity of seed distribution, density of plants per hectare, operation cost per hectare, Planting depth, row spacing adjustment, number of workers (human labor) required for used grain drill, yield production and possibility of simultaneous broadcast seed and fertilizer. After studying these factors and with considered effect any factor on performance grain drills and using of general performance indicator, overall outcome in each grain drill calculation and the results were compared together. The final results showed that grain drill combined (with seed and fertilizer tank) in the state of Gujarat has been the best performance and the most suitable grain drill for Orsay India region [6]. Also, in a study to evaluate the effect planter speed on the seed spacing uniformity in pneumatic Gaspardo Sp 520 model was tested. Results showed that in speed 5 km h^{-1}, the best uniformity is obtained in terms of distance between seeds. Therefore, the Coefficient of Variation (CV) was in minimum value [7]. Research of Fornstor and Becker in testing seed distribution uniformity in the use of pneumatic planter for plants such as canola, barley, wheat and oat indicated that seed distribution by the pneumatic planter is more uniform and accurate [8]. Another study at University of Michigan for assessment of sugar beets planter were done. In this design, four planter models (Accord planter mechanical, Deer 1 pneumatic planter, Monosem pneumatic planter and Stanhoy 3 pneumatic planter) with two tillage systems, two Speed and two kinds of seed together were compared. This project was conducted in two separate areas and were determined that the highest percentage of sugar beet emergence corresponding to the use of planter pneumatic and minimum value was related accord planter mechanical [9]. Therefore, this research conducted to aim study and evaluate a variety of soybean cropping machine with different cropping pattern to select the best soybean planting machine and achieve to highest yield in Moghan region.

MATERIALS AND METHODS

The study was performed in 2011-2012 at the agricultural research center of Ardabil Province (Moghan) (39°39′N; 48°88′E; 78 m a.s.l.) in Northwest of Iran. The mean annual precipitation and temperature at the station are 332 mm and 21.5°C, respectively. The values of some physical and chemical properties of the soil are given in Table 1.

This study was conducted to evaluate and to select a suitable soybean planting machine for Moghan region. In order to evaluate different planters for mechanized

Table 1: Physical and chemical properties of experimental soil planted

Texture	Sand (%)	Silt (%)	Clay (%)	Organic carbon (%)	Electrical conductivity (dSm^{-1})	Saturated soil acidity (pH)	Depth (cm)
Clay	10	29	61	0.98	1.0	7.4	0-27
Clay	10	27	63	0.37	1.3	8.2	27-70

Table 2: Planter specifications used in the experiment

Type planter	Number row	Work width	Type hitch to tractor	Press wheel	Type covering	Type Opener	Metering mechanism
Deep seed drill (John Deere N09000x03868)	12	3	Mounted	Open center Rubber	Runner	Runner	Fluted roller
Barzagar Hamadan grain drill (FK2.5-15,3)	12	3	Mounted	-	Knife	Runner	Fluted roller
Gaspardo pneumatic row planter (SP-F4)	4	2	Mounted Rubber	Open center Rubber	Runner	Runner	Horizontal plate Metering
Node pneumatic row planter (PW2000AC700008)	4	1.5	Mounted	Rubber	Runner	Runner	Horizontal plate Metering

Table 3: Seed specifications used

Thousand grain weight (g)		Seed viability (%)		
Second year	First year	Second year	First year	Cultivar
178	174	84	89	L17

soybean cultivated in two ways under dry and wet seedbed condition planting by using a randomized complete block design with six treatments and four replications. The planter types were consisted of cereal deep seed drills (John Deere) under wet seedbed condition with 25 and 50 cm in row spacing as the first and second treatments, T1 and T2, respectively (conventional methods), grain drills from Barzagar Hamadan with 25 and 50 cm in row spacing as third and fourth treatments, T3 and T4, respectively and Gaspardo pneumatic row planters with 50 cm in row spacing as the fifth treatment, T5 and Node two-row ridge planter with 75 cm in row spacing as the sixth treatment, T6. (T3, T4, T5 and T6 cultivated under dry seedbed condition). Technical specifications planters are given in Table 2.

After the grain harvest, parts of the land with the length and width of each plot were 25 and 6 m with spacing 4m in each block were selected. Before treatments, all phosphorus (200 $kgha^{-1}$ P_2O_5), one third of nitrogen (urea 100 $kgha^{-1}$ and remainder during the growing period in two stages) and the herbicide of pre-emergency Sonalan (3 $l.ha^{-1}$) was added to the soil. Seeding density (100-110 $kgha^{-1}$) of Common varieties of the region (L17) planted with using machine selected for evaluation in early June.

Seed Planter Evaluation Indices: In this study with adjustment planter machine (in deep seed drill and grain drill Hamadhan machines, at the same time, a Static test and field, the necessary amount of seeds by metering mechanism Fluted roller) in row planter with change distance between plants (using of different plate) uniform density and uniform planting depth for treatments were applied. Indicator of planter evaluation for measuring includes number and percentage of germination. Distance between green plant, field capacity and uniformity index of seed longitudinal and lateral distances. To determine the number of plants was green and germination percentage on each plot, five points with length of 0.5 m and gap width between rows selected. After the establishment of the plant, the number of seeds sprouted counted and accurately were recorded. Mean number of germinated seeds and germination percentage in unit area was calculated from the following equation [7].

$$PE = \frac{n}{N} \times 100 \quad (1)$$

PE, percentage germination of seeds in the soil, n: number of germinated seeds counted per unit area, N: number of seeds that have been planted in nominal unit.

For the determine field capacity planter machine in each experimental plot, total time measurement and effective field capacity each machine (planter) calculated with using the following relationship:

$$FCe = \frac{A}{Tt} \quad (2)$$

That, A: The level of work performed ($ha\ h^{-1}$), Tt: total time spent (h), FCe: Effective field capacity ($ha\ h^{-1}$).

To determine longitudinal uniformity index of seed distances in linear planter machines, (drill grain and row planter), in middle level per plot, distance 30 plant measured, then by using the following equations, Seeds longitudinal spacing uniformity index was calculated [10].

$$sd_s = \sqrt{\frac{\sum_{i=1}^{n} S_i^{\,2} - \frac{\left(\sum_{i=1}^{n} S_i\right)^2}{n}}{n-1}} \quad (3)$$

$$SSE = \frac{S_a - sd_s}{S_a} \quad (4)$$

SSE: uniformity on the desired index, S_a: Average distances measured. sd_s: Standard deviation distance, Si: The distance measured in the ith point, n: number of samples (Measuring distances).

To determine uniformity index of seeds lateral distance in liner planter machine (grain drill and row planter) in the middle per plot by put a bar Length one meter in middle rows, lateral distances of each plant to the bar measured and by using equation above, uniformity index of seeds lateral distance was calculated. During the growth stage, the necessary care, including combat pests and weeds equally and furrow irrigation (leakage) was done. Finally, yield and yield components includes number of pods per plant, length pod, distance of first pod from land, Seeds per pod, one hundred seeds weight and plant height for each plot calculated.

RESULTS AND DISCUSSION

Analysis of variance for percentage germination index in planting methods show statistically has been significant at1% level (Table 4). Comparison of mean planting machine indicated in row planters with an average of 87.32 germination percent were at the highest level and deep seed drill and grain drill with a mean of 83.56 and 74.93 were in the next category, respectively (Table 5). It should be considered that germination percentage in addition to the characteristics of the seed and seed viability percent, depends on preparation of suitable land, depth of seed placement, irrigation methods and climatic conditions (air and soil temperature for germination). A higher percentage of germination in row planter method due to faster drying ridge and sensitivity seed oil (soybean) to high temperature and moisture is justified that these results match with research [9].

According to the results of analysis of variance uniformity index of seeds Longitudinal distances (%) in planting methods, A significant difference was found in 1% level (Table 4) therefore comparison of mean machine planting showed pneumatic row planter with two row on ridge and one row on ridge with 83.95 and 82.13% had highest level and Deep drill and grain drill were in the lower levels, respectively (Table 5). Row planter because of nature of construction and also having metering mechanism more accurate, than deep seed and grain drill have high uniformity index of Longitudinal distances and Low distribution coefficient that results also showed this issue but in compared deep seed drill and grain drill, due to greater planting depth grain drill and better coverage seed that by metering mechanism fluted roller, randomly in their grooves drop to pipes collapse, suitable than grain drill. Also results analysis of variance uniformity index of seed lateral distance in planting methods, a significant difference was found in 1% level (Table 4).

Comparison mean seeding machine revealed pneumatic row planter and deep seed drill have highest index of uniformity to transverse distances and grain drill with row spacing planting 25, 50 cm respectively 73.87 and 73.19 percent, had the lowest level of the index. Greater uniformity index lateral distances in row planter and deep seed drill rather grain drill, due to the nature of two devices in terms of appropriate cover soybean seed in soil bed and less distribution is justified. Similar results were reported by Senapati *et al.*[6] and Smith *et al.* [10] Also, in terms of field capacity planting method with pneumatic row planter due to the high work speed have highest level of this index with medium 1 ha h^{-1} and in the next stage deep seed drills and drain drills were located (Figure 1).

Results of analysis variance for yield and yield components indicated that in terms of seed yield traits, number of plants per unit area (m^2), number seeds per pod, a significant difference between planting methods in 1% level and in terms of the indicator first pod of land surface there was a 5% probability level. In other traits such as plant height, length pod, seed weight, number of pods per plant, there wasn't any difference observed (Table 4). Therefore, maximum and minimum yield in this experiment related to T6 (Node two-row ridge planter with 75 cm in row spacing) with 2864 kg ha^{-1} and T4 (grain drills from Barzagar Hamadan with 50 cm in row spacing) with 2252 kg ha^{-1} (Table 5) that results represent an important relation between grain yield and seed evaluation index include germination percentage and establishment appropriate number of plants with desirable plants per unit area. Therefore, attention to the role of plant density on the creation of appropriate vegetation, use of production factors and its effect on principles and yield components very important [11]. Also, Fig. 1 indicate difference in optimal planting pattern between

Table 4: Mean square of different planter methods of cultivated soybean in two years on investigation indexes

		Mean Square (MS)				
SOV	d.f	Germination percentage	Uniformity index of seeds longitudinal distances	Uniformity index of seeds lateral distances	Plant height	Yield
Year	1	3.52^{ns}	67.78^{ns}	12.63^{ns}	200.08ns	4716294.08**
Replication	6	10.42	23.06	19.38	116.20	42349.58
Treatment	5	116.47**	719.28**	310.76**	39.73^{ns}	343992.08**
Treatment*	5	6.17	1.71	15.54	29.08	57951.08
Year (T*Y) (E) Error	30	6.22	16.56	14.35	36.34	38306.21
Coefficient Variation (%)		2.99	5.72	4.69	6.98	7.66

**, ns indicates significance at 1% and not significant

Table 5: Mean different planter methods of cultivated soybean in two years on investigation indexes

Type planter and cropping pattern	Germination percentage (%)	Uniformity index of seeds longitudinal distances (%)	Uniformity index of seeds lateral distances (%)	Plant height (cm)	Yield (kg ha^{-1})
Crop year					
2011	83.75	69.91	81.39	84.37	2241.25^{b}
2012	83.30	72.29	80.37	88.45	2868.16^{a}
Treatment					
T1: deep seed drills (John Deere) with 25 cm in row spacing	86.62^{a}	65.00^{bc}	81.37^{b}	86.37	2531.62^{b}
T2: deep seed drills (John Deere) with 50 cm in row spacing	80.5^{b}	68.62^{b}	82.18^{b}	83.12	2462.12^{b}
T3: grain drills from Barzagar Hamadan with 25 cm in row spacing	78.75^{b}	62.32^{c}	73.87^{c}	84.75	2528.50^{b}
T4: grain drills from Barzagar Hamadan with 50 cm in row spacing	71.12^{b}	64.58^{bc}	73.19^{c}	87.00	2252.50^{b}
T5: pneumatic row planters with50 cm in row spacing	87.25^{a}	82.13^{a}	86.80^{ab}	87.87	2689.37^{ab}
T6: Node two-row ridge planter with 75 cm in row spacing	87.62^{a}	83.95^{a}	87.87^{a}	89.37	2864.12^{a}

Means, in each column and for each factor, followed by similar letter(s) are not significantly different at the 5% probability level-Using Duncan's Test

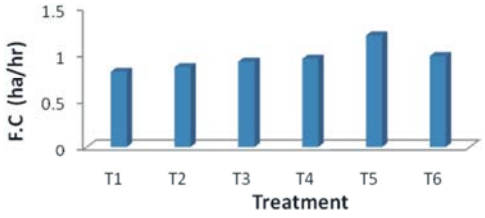

Fig. 1: Field capasity of different treatments for planting Soybean

row planters and grain drills. With this said all, with regard to advantage row planters in comparative to other soybean planter in Moghan region for mechanized operations perform such as fight against weeds, sprayer, fertilizer application in wide area and as well as higher yield T6 (Node two-row ridge planter with 75 cm in row spacing) is recommended.

Fig. 2: Image of soybean planting row in pneumatic row planter with two row on ridge (right) and grain drill (left)

CONCLUSION

- Row planters with average germination percentage (87.32%) were at the highest level that according to soybean seed oil and its sensitivity to heat of over 35°C in the region, with faster drying ridge, there has been possibility appearance faster seed.
- In terms of uniformity index of seed longitudinal distances, pneumatic row planters with two and one row on ridge 83.95 and 82.13 % highest percentage levels have been, respectively. Also in terms of the uniformity index of seed lateral distances in compared with deep seed drill and grain drill have the best Coefficient of uniformity seed loss. Row planters because of having more weight Relative to each unit planter, Stronger connections openers and press wheel, possibility lateral movement for per planting unit in compared with deep seed drill and grain drill is less and caused that this index bigger for row planters related other planting machine.
- Maximum yield in this experiment is related to T6 (pneumatic row planter with two row on ridge and 75cm in row spacing) with a mean 2864 kg ha^{-1}.
- It is recommended to research in the field seed consumption rate with conventional methods of seeding soybean to be done. Also design and construction of suitable machinery two row planter in order to reduce consumer seed and Improved planting pattern is recommended for next step.

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