WALIA journal 31(S3): 152-157, 2015
Available online at www.Waliaj.com
ISSN 1026-3861

Effects of seed drills in no-tillage and customary tillage on seed corn yield in northern Khuzestan

Mohammad Mehranzadeh [1], Karim Eslamizadeh [2, *]

[1]*Assistant Professor, Department of Agricultural Machinery, Dezful Branch, Islamic Azad University, Dezful, Iran*
[2]*Student MSc Agricultural Mechanization Engineer, Department of Agricultural Machinary, Dezful Branch, Islamic Azad University, Dezful, Iran*

Abstract: A split-plot experiment was carried out using a randomized complete block design in agricultural lands of Dezful in the cropping year 2013 with three replications to study the effects of seed drills on yield of various seed corn cultivars in no-tillage and customary tillage systems. The main plot of planting types at three levels were; (A) the customary practice (three disking operations and a 4-row pneumatic seed drill made by the Iranian company Tarashkadeh), (B) direct planting of seed corn using a 4-row no-till drill model HWS Sfoggia made in Italy, and (C) direct planting of seed corn using a 6-row no-till seed drill model SPD 3000 made by Baldan Company in Brazil. The corn cultivars (a) SC 704, (b) NS 640, and (c) SC Karoun 701 were the subplot. Results showed that the various seed drills were significantly different in percentage breakage of seeds at the 1% probability level, with the pneumatic seed drill made by Tarashkadeh having the maximum and the Sfoggia and Baldan seed drills the minimum percentage breakage of seeds. The seed drills were also significantly different at the 1% level of probability in the accuracy of the longitudinal distance between seeds in the planted rows, with Sfoggia and Baldan direct drill planters having the highest and the pneumatic Tarashkadeh drill the lowest uniformity in the longitudinal distance between the seeds in planted rows. As for uniformity in planting depth, the seed drills were significantly different at the 5% probability level, with the Baldan and Sfoggia direct drill planters enjoying the greatest and the pneumatic Tarashkadeh seed drill the smallest uniformity in planting depth. Comparison of the results indicated that corn yield using the Sfoggia direct drill planter was 4.35% and 20.58% higher than those obtained by employing the Baldan direct drill planter and the Tarashkadeh pneumatic seed drill, respectively. Seed yield of the SC 704 cultivar was 12.89% and 16.61% higher compared to those of the NS 640 and SC Karoun 701 cultivars, respectively. Results of this study showed that direct seeding of the corn cultivar SC 704 with the Sfoggia or Baldan seed drill was the most suitable for the region considering the studied parameters related to each of the seed drills, and yield and yield components of seed corn.

Key words: *Direct drill planter; No-tillage; reduced tillage; Customary tillage; Corn cultivars*

1. Introduction

Because of the alarming rate of increase in world population, natural resources (including water and soil) providing foodstuff for people are facing serious limitations and shortages in supplying the extra food materials required. Decreasing per capita arable land causes activities to be focused on yield increase per unit area and time, although this has been accompanied by severe damages to the environment. Barzegar et al. (2003) stated that planting crops under a broad spectrum of environmental conditions using no-tillage and reduced-tillage systems could result in equal, or even higher, yields than the customary practices. Soil organic matter is preserved better in no-tillage systems because of decreased oxidation (Wilkins et al., 2002), and retention of organic matter on soil surface reduces soil erosion and increases water holding capacity (Lopez *et al.*, 2003). In another study, Johnson and Sanders (2003) compared no-tillage and customary tillage practices in cotton fields and concluded emergence and number of bolls in the customary system were 6 and 2 percent higher and lower, respectively, compared to the no-tillage practice, and that there were no statistically significant differences in yield by employing these two systems. Maral (2004) reported conservation tillage increased soil organic matter in the long run because this type of tillage reduces soil temperature and increases soil moisture (conditions under which the rate of organic matter decomposition declines). Increases in soil organic matter usually takes place at the depths of 5-10 cm. Suzy Friedman et al. (2010) reported that corn yield in customary tillage practice was 21% higher than the reduced tillage system, with the maximum fuel consumption (33.48 L/ha) in the customary practice and the minimum (6.6 L/ha) in the no-tillage system. Samarajiva et al. (2006) showed that the conservation tillage system could result in higher yields compared to customary tillage practice because it improves soil quality and water use efficiency. Yalkin and Kakir (2006) noted the maximum corn yield was achieved by two subsoiling

* Corresponding Author.

operations carried out in the two years of their experiment and the minimum in the direct seeding practice. De Vita *et al.* (2007) studied the effects of no-tillage and customary tillage practice on wheat yield and obtained higher yields using the no-tillage system. Therefore, despite the remarkable increases in the yields of crop plants resulting from production and proliferation of new varieties, direct seeding, and from farmers' experiences, yield responses of plants to tillage systems are usually influenced by local conditions, soil type, and climate. Moreover, seed corn yields have declined considerably in recent years in northern Khuzestan, considering the fact that farmers prepare their lands using customary tillage practices with no rotation and fallow and no change in cultivars, and successive planting of wheat and corn. Therefore, it is possible to raise yield through using suitable seed drills and corn cultivars.

2. Materials and Methods

In order to study the effects of seed drills type on yields of various seed corn cultivars in no-tillage and customary tillage systems, the present experiment was conducted in Dezful (at 82 meters above sea level with annual rainfall of 250 mm) in Khuzestan Province in the cropping year 2013. The split-plot experiment was carried out using the randomized complete block design with three replications. The main plot and the subplot included three levels of planting and three levels of corn cultivars, respectively.

The main plot was the various planting methods using different seed drills in the main plots at three levels. These included the customary practice of three disking operations and planting with a pneumatic seed drill made by the Tarashkadeh Company (a_1), direct seeding with a 4-row no-till HWS model Sfoggia drill (a_2), and direct seeding with an SPD 3000 Baldan drill (a_3). The three levels of corn cultivars in the sub plots included SC 704 (b_1), NS 640 (b_2), and SC Karoun 701 (b_3). The rows in all the 27 by 80 meter main plots and in the 9 by 80 meter sub plots were 75 cm apart, with a distance of two meters between adjacent treatments and a distance of 8 meters between adjacent replications to allow maneuvering the equipment in the triple operations of planting, maintenance, and harvesting. In the treatment of customary planting (with three replications), three disking operations (disc harrow) were carried out at the depth of 17 cm using the Tarashkadeh seed drill made in Iran and a 90 HP Ferguson 399 tractor. In the direct seeding treatments, a 4-row no-till HWS model Sfoggia seed drill and a no-till SPD 3000 model Baldan seed drill were used, and 120 HP Valtra tractors pulled both seed drills.

The quantity of seeds planted in each plot was determined based on seeds spacing of 16 cm in a row, 1000-seed weight, and seeds viability. Since the 1000-seed weights in the SC 704, NS 640, and SC Karoun 701 cultivars were 263, 342, and 330 grams, respectively, the quantity of planted seeds for the cultivars were 21.2, 28.4, and 27.4 kg/ha, respectively. All three cultivars had a viability of 88% (as determined in the laboratory), therefore, the quantity of seeds planted for each cultivar in all main plots and subplots and replications was 10% more than the calculated figures.

3. Parameters and factors measured in the project:

Percentage breakage of seeds, accuracy of seed drills in the longitudinal spacing between seeds in the rows, percentage of uniformity in planting depth, seed yield, and biological yield were measured as described below.

3.1. Percentage breakage of seeds

Percentage breakage of seeds was calculated using the following equation for each seed drill. To increase the accuracy, the measurement was repeated three times.

Percentage breakage of seeds = (Total number of seeds – Number of intact seeds)/Total number of seeds $\times$ 100

3.2. Uniformity of planting depth

After full emergence of seedling and establishment of stand, about 30 germinated plants were randomly selected in each plot and gently pulled out of the ground. The distance from the seed to where the stem was pale due to lack of sunlight was measured with a ruler. The mean of the obtained figures was equal to the planting depth.

Accuracy of the drills in planting seeds at the suitable longitudinal spacing in the rows

The lateral spacing of plants on planted rows from an imaginary line parallel to the rows was measured with a ruler. The Senapati equation was then employed as follows:

$$Se = (1 - y/d) \times 100$$

Where she is the uniformity coefficient of seed distribution in percent, d the mean obtained or adjusted spacing between seeds in cm, and y the mean of the absolute values of the difference between the data and their mean or the adjusted spacing.

3.3. Harvesting

After reaching physiological maturity, 4 m^2 samples were randomly taken from the middle rows of each plot. The plants were cut from 1 cm above soil surface, all cobs were harvested, their woody axes and green cover were removed, and the total wet weights of the plants were measured.

3.4. Statistical calculations

MSTAT-C was employed for ANOVA and comparison of the means (using Duncan's test). Excel was used for drawing the diagrams.

4. Results and discussion

4.1. Percentage breakage of seeds

One of the parameters studied in this research was percentage breakage of seeds in the drills. As shown in Table 1 of ANOVA, the effects of the seed drills on percentage breakage of seeds were significant at the 1% probability level.

Table 1: Results of ANOVA concerning percentage breakage of seeds

Sources of variation (S.O.V)	Degree of freedom (d.f)	Mean squares (M.S)	F-value
Replication	2	0.870	1.633 n.s
Drills	2	72.925	564.138**
Experimental error	4	0.652	
Corn cultivars	2	1.1	8.4 n.s
Mutual effects of drills and corn cultivars	4	0.372	3.192 n.s
Experimental error	12	0.124	
Coefficient of variation (%)		10.42	

The symbols ** and * stand for significant difference at the 1 and 5% probability levels, respectively, and n.s signifies lack of significant difference

As shown in Fig.1, which compares the means of percentage breakage of seeds, the maximum percentage breakage of seeds (6.4%) belongs to the pneumatic Tarashkadeh seed drill, while the Sfoggia and Baldan direct drill planters have the lowest percentage breakage of seeds.

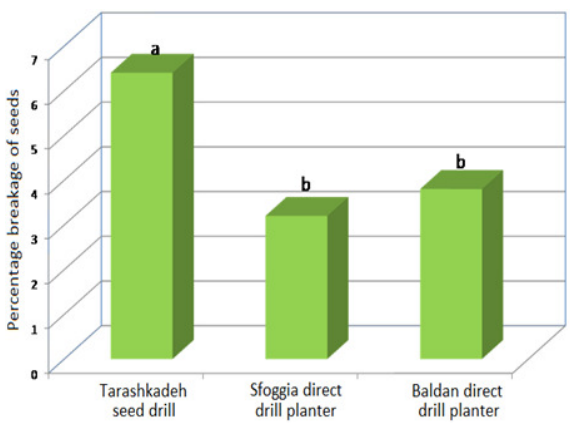

Fig.1: Comparing the means of percentage breakage of seeds in the seed drills

The reason for the high percentage of seed breakage in the Tarashkadeh seed drill is that corn seeds enter the space between the perforated screen of the planter and the planter body and break. This screen does not stick to the planter body; that is, a little gap exists between the rotating perforated screen and the planter body and the seeds on the base of the planter are broken.

4.2. Accuracy of the seed drills in providing the suitable longitudinal spacing between seeds in planted rows

The accuracy index in providing the longitudinal spacing between seeds in planted rows of various treatments was studied. Based on results of ANOVA in Table 2, the effects of the seed drills on the accuracy of the longitudinal spacing between seeds were significant at the 1% probability level.

Table 2: ANOVA of the coefficient of uniformity in the longitudinal distance between seeds

Sources of variance (S.O.V)	Degree of freedom (d.f)	Mean squares (M.S)	F-value
Replications	2	3.356	0.923
Drill planters	2	273.824	53.633**
Experimental error	4	4.237	
Corn cultivars	2	8.61	4.329 n.s
Mutual effects of drills and corn cultivars	4	17.422	7.215 n.s
Experimental error	12	2.312	
Coefficient of variation (%)	-	2.93	

The symbols ** and * stand for significant difference at the 1 and 5% probability levels, respectively, and n.s signifies lack of significant difference

As shown in Fig.2, comparing the means of uniformity in providing longitudinal spacing between the seeds in rows shows that the best uniformities were those of the Sfoggia and the Baldan drill planters with 60.12% and 59.82%, respectively, and the worst that of the pneumatic Tarashkadeh seed drill with 53.82%.

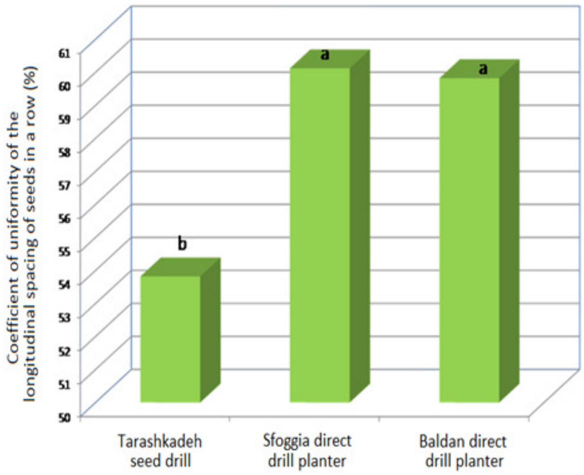

Fig.2: Comparing the accuracy of the drills in providing uniform suitable spacing between the seeds in rows

The reason for the low accuracy of the Tarashkadeh seed drill is that the planter system uses vacuum suction, while the Sfoggia and Baldan seed drills have accurate mechanical planter systems so that seeds move more uniformly along their path.

4.3. Percentage uniformity of planting depth

Another studied parameter in the research was uniformity of planting depth. As Table 3 of ANOVA indicates, the effects of the various seed drills were significant at the 5% probability level.

Table 3: ANOVA of the index related to uniformity in planting depth

Sources of variance (S.O.V)	Degree of freedom (d.f)	Mean squares (M.S)	F-value
Replications	2	3.332	0.839
Drills	2	19.420	5.147*
Experimental error	4	6.24	
Corn cultivars	2	11.652	3.422 n.s
Mutual effects of drills and corn cultivars	4	6.258	2.387 n.s
Experimental error	12	4.512	
		2.17	

The symbols ** and * stand for significant difference at the 1 and 5% probability levels, respectively, and n.s signifies lack of significant difference

The diagram comparing the means indicates the maximum uniformities in planting depths were those of the Baldan and Sfoggia seed drills with 86.54% and 86.47%, respectively, and the minimum (82.51%) that of the pneumatic Tarashkadeh seed drill.

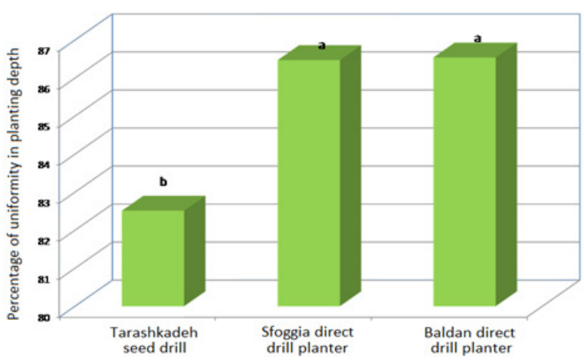

Fig.3: Comparing the mean percentage of uniformity in planting depth by the seed drills

Sfoggia and Baldan direct drill planters easily penetrate into the soil and enjoy greater uniformity of planting depth because their furrow openers are of the double-disk type, but the Tarashkadeh seed drill adjusts depth by pressure wheels and if they meet with terrain changes or strike clods, depth adjustment is disrupted.

4.4. Seed Yield

Based on Table 4 of ANOVA, the effects of the seed drills and cultivars on seed yield were significant at the 5% and 1% levels of probability, respectively, but the mutual effects of the seed drills and cultivars on seed yield were not significant.

Table 4: Results of ANOVA related to biological and seed yields

Sources of change	Degree of freedom	Biological yield	Seed yield
Replications	2	2488446.33 n.s	1675452.6 n.s
Drills	2	12448187.83*	8234849.7*
Error	4	1227142.12	753216.4
Corn cultivars	2	156388.65 n.s	6128**
Mutual effects	4	1455339.16 n.s	882545.4 n.s
Error	12	1663269.63	394890.8
Coefficient of variation		10.72	13.28

The symbols ** and * stand for significant difference at the 1 and 5% probability levels, respectively, and n.s signifies lack of significant difference

Based on Fig.4 that compares the various seed drills, the Sfoggia and Baldan direct drill planters had yields of 5933 and 5675 kg/ha, respectively, which were greater than that of the Tarashkadeh seed drill. These results conform to those found by Yalkin and Kakir (2006). Moreover, comparison of the means in Diagram 5 indicates that the seed yield of the cultivar SC 704 (6130 kg/ha) was than those of the other two cultivars.

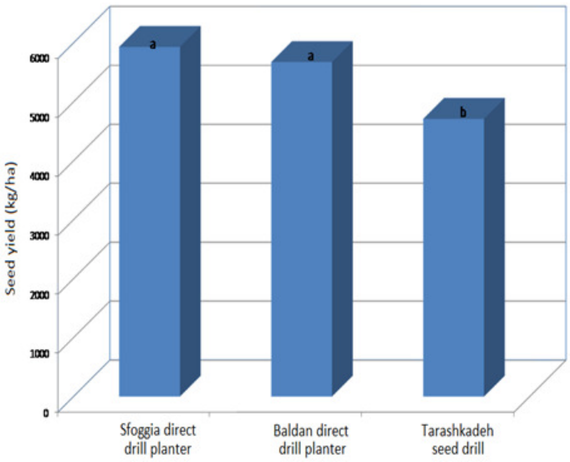

Fig.4: Comparison of the effects of the seed drills on seed yield

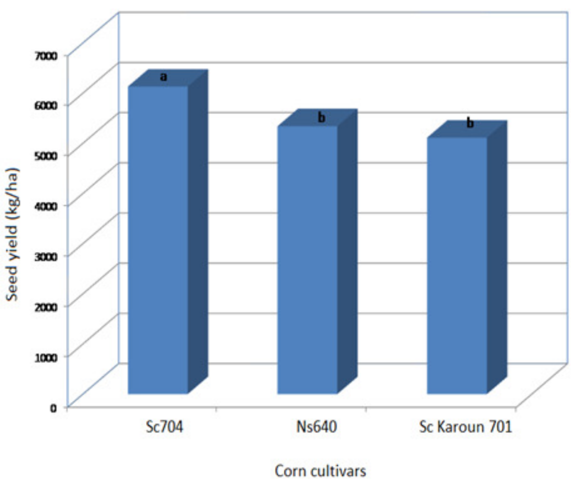

Fig.5: Comparison of the mean seed yields of the cultivars

4.5. Biological Yield

Based on Table 4 of ANOVA, the effects of the seed drills on biological yield were significant at the 5% level of probability, but the effects of cultivars and the mutual effects of cultivars and seed drills on biological yield were not significant.

Comparison of the means in Diagram 6 demonstrates that biological yields per unit area in direct drill planting with Sfoggia and Baldan seed drills were in one statistical group, but that they were larger than the biological yield obtained by using the Tarashkadeh seed drill.

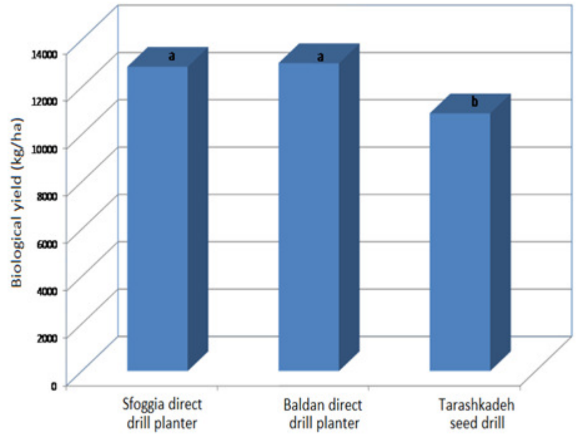

Fig.6: Comparison of the means of biological yield in using various seed drills

5. Conclusion

Results of this research showed that the effects of seed drills on percentage breakage of seeds were significant at the 1% probability level, with the maximum seed breakage (6.4%) belonging to the pneumatic Tarashkadeh seed drill and Sfoggia and Baldan direct drill planters having the minimum seed breakage. The effects of seed drills on accuracy in providing the suitable longitudinal spacing between seeds in planted rows were significant at the 1% probability level, with the highest uniformity obtained by using the Sfoggia and Baldan direct drill planters with 60.12% and 59.82%, respectively, and the lowest by the pneumatic Tarashkadeh seed drill with 53.82%. As for uniformity in planting depth, the effects of the drills were significant at the 5% probability level, with the Baldan and Sfoggia direct drill planters enjoying the maximum uniformity with 86.54% and 86.47%, respectively, while the Tarashkadeh pneumatic seed drill had a uniformity of 82.51%. Comparison of the means revealed that the seed yield using the Sfoggia direct drill planter was 4.35 and 20.58% higher than those obtained when the Baldan direct seed planter and the Tarashkadeh seed drill were employed. The seed yield in the SC 704 cultivar was 12.89% and 16.61% higher compared to those of the NS 640 and AC Karoun 701 cultivars, respectively. Therefore, it is recommended that the Sfoggia and Baldan direct seed planters and the cultivar SC 704 be used for this region because they achieved the maximum seed and biological yields.

References

Barzegar, A. R., M. A. Asoodar, A. Khadish, A.M. Hashemi and S. J. Herbert, 2003. Soil physical characteristic and chickpea yield response to tillage treatments. Soil & Tillage Research, 71:49-57.

De Vita, P., E. Di Paolo, G. Fecondo, N. Di. Fonzo and M. Pisante, 2007. No-tillage and conventional tillage effects on durum wheat yield, grain quality and soil moisture content in southern Italy. Soil and Tillage Research, 92: 69-78.

Jonson, J. R and Sunders, J. R. 2003. Cotton plant response to tillage systems, Annual Report 2002 of the north Mississippi research center, Information bulletin, 398, 122-124.

Lopez, M. V., D. Moret, R. Gracia and J. L.Arrue, 2003.Tillage effects on barley residue cover during follow in semiarid Aragon. Soil & Tillage Research, 72: 53-64.

Murrell, S.2004. Efficient fertilizer use (section tillage and fertilizer intraction).

Samarajeewa, K. B. D. P., T. Horiuchi and S. Oba, 2006. Finger millet (Eleucine corocana L. Garetn) as a cover crop on weed control, growth and yield of soybean under different tillage systems. Soil & Tillage Research, 90: 93-99.

Sessiz, A., Alp. A., and Gursoy, S. 2010. Conservation and conventional tillage nethods on selected soil physical properties and corn(*Zea mays* L.) yield and quality under cropping system in Turkey. Bulgarian Journal of Agricultural Science, 16(5):597-608.

Wilkins, D. E., M. C. Simens and S. L. Albrecht, 2002. Changes in soil physical characteristics during transition from intensive tillage to direct seeding. Transactions of the ASAE, 45(4), 877-880.

Yalcin, H. and E. Cakir, 2006. Tillage effects and energy efficiencies of sub soiling and direct seeding in light soil on yield of second crop corn for silage in western Turkey. Soil & Tillage Research., 90: 250-255.