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Tillage Method and Seed Rate Effects on Dryland Winter Wheat

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Abstract: Conducted researches showed that seed rate and tillage method could be affecting the yield of dryland wheat. Therefore, the objective of present study is to study tillage method and seed rate effects on grain yield and some yield components for dryland winter wheat at Maragheh located at the north-west of Iran. The Field soil was loamy clay and experiments were conducted for two years. Sixteen treatments were laid out in Completely Randomized Blocks (CRB) with a split-split plots design with four replications. Treatment combinations comprised two cropping years, 2 levels of tillage methods including TM1 = without mold board and TM2 = minimum tillage and 4 levels for seeding rates comprising SR1 = 100, SR2 = 125, SR3 = 150 and SR4 = 175 kg ha^{-1}. Results revealed that interaction of tillage method and seed rate had a significant effect on grain yield. Maximum and minimum yield acquired from TM2×SR3 and TM2×SR2 with yield of 1329 and 1097 kg ha^{-1}. The interaction of year and seed rate was statistically significant on 1000 grain weight, spike length, grains spike^{-1} and spike m^{-2}. It seems the year effect is originated from rainfall that occurred as 346.3 and 201.70 mm in the consecutive two years. Also, non significant effect was observed due tillage methods, seed rate and its interaction on plant height. Also, results showed that 1000 grain weight, spike length, grains spike^{-1}, spike m^{-2} and plant height ranged from 37.88 g, 6.323 cm, 21.422, 507.6, 71.144 cm to 27.45 g, 3.142 cm, 7.296, 301.00, 42.094 cm, respectively.

Key words: Dryland wheat, tillage method, wheat seed rate

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the world's major crop source of calories and protein (Stewart and Nielsen, 1990). Wheat is a main source of nourishment and the principal food grain produced in Iran (Nasseri and Fallahi, 2007) that being grown on some 5.5 million hectares in this country. The potential yield of wheat is depending on optimum seed rate. There will be competition among plants for water and nutrients and sunlight for more seed rate and there will be less number of plants per unit area for less seed rate. As reported by Rajput *et al.* (1989) the maximum grain yield is obtained with increase in seed rate. Also, Bhatnager *et al.* (1991) found that grain yield increased with the in crease in the seed rate from 100 to 200 kg ha^{-1}. Also, Ayaz *et al.* (1997) concluded that biological yield increased with increase in seed rate. With increase in seed rate the number of plants m^{-2} is increased, while 1000 grain weight was decreased (Kovac, 1978). Planting rate for irrigated winter wheat are mostly in the range of 60 to 100 kg ha^{-1}, plant densities are 120 to 200 m^{-2} and head densities are 500 to 800 m^{-2}. Spring wheat produce less grain on tiller heads than winter wheat and seeding rate are normally about 50% higher, while head densities tend to 20 to 30% lower (Stewart and Nielsen, 1990). Khan *et al.* (2002) reported that seed rate and varieties had significant effects on emergence m^{-2}, tillers m^{-2}, number of productive tillers m^{-2}, plant height, days of maturity, grain spike^{-1}, 1000 grain weight and grain yield under irrigated conditions. The maximum (2345.90 kg ha^{-1}) and minimum grain yield (1676.57 kg ha^{-1}) was obtained in those plots which were sown with 150 and 50 kg ha^{-1}. Asrar and Kanemasu (1985) found that reducing planting rate from 67 to 24 kg ha^{-1} for two cultivars reduce average LAI after joining by 20%, grain yields by 27%, seasonal ET by 17% and WUE by 9%. Asgari-Meidani (2006) reported that maximum grain yield (=1452 kg ha^{-1}) was obtained with treatment of chopping stubble by rotary plow and plowing by chisel plow in fall and ducks foot in spring and planting by seed drill in after fall. Also they concluded that chopping of stubble and chisel plow in autumn and sweep in spring increases soil moisture content, increase crop yield and reduce bulk density of soil. Shamsabadi (2006) reported that application of chisel plow with 140 kg ha^{-1} seed density with deep drill planting machine are recommended to increase wheat yield in Gonbad located at the north of Iran. The objective

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of present study is to study influence of tillage methods and seed rates on grain yield and some yield components of dryland winter wheat.

MATERIALS AND METHODS

The field experiments were conducted during 1997-1998 and 1998-99 at the Agricultural Research Institute of Maragheh, Iran (latitude 37° 15' N, longitude 46° 22' E and 1720 m above mean sea level). The maximum and minimum temperature averaged as 36.7 and 4.8° C, respectively. The field soil was loamy-clay. During the crop growing season of 1997-98, cumulative pan evaporation and rainfall were 1223 and 346.3 mm, respectively. During 1998-1999 these factors were 1133 and 201.7 mm, respectively (Fig. 1).

Wheat was sown during the early days of the Oct. of two cropping years on six rows 5.5 m long and 20 cm apart (5.5×1.2 m^2 plots). Sixteen treatments were laid out in completely randomized blocks with a split-split plots design with four replications. Treatment combinations comprised 2 cropping years, 2 levels of tillage methods and 4 levels for seeding rates of wheat. Tillage methods including TM1 = without mold board and TM2 = minimum tillage with plot size of 30×5.5 m^2, tillage practices were done by a tractor with power of 65 hp. Tillage practices were done in the fall of year whose land was fallow. Seeding rates treatments including SR1 = 100, SR2 = 125, SR3 = 150 and SR4 = 175 kg ha^{-1} with plot size of 7×5.5 m^2. N up to 30 kg ha^{-1} in the form of urea was applied to the soil in the sowing time and spring. P up to 60 kg ha^{-1} was applied to the soil in the sowing time. The crop was managed well with respect to weed and disease control. Plant height was measured by 15 plant and spike length, number of grain in the spike and 1000 grain weight was measured by 15 spikes at each plot. After maturity for border effect, 50 cm from the both sides of plots was omitted, therefore plots in 4.5×1.2 m^2 were harvested for grain. The collected data during the experiment was analyzed according to RCB design and mean values compared with Least Significant Differences (LSD) test (Steel and Torrie, 1980).

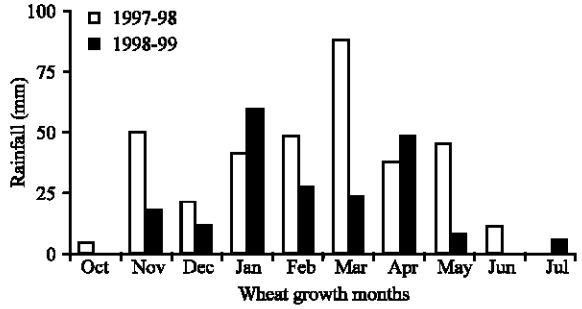

Fig. 1: Occurred rainfall (mm) during two cropping years. cumulative rainfall was 346.3 and 201.70 mm in the two cropping years

RESULTS AND DISCUSSION

The grain yield is significantly affected by year at 5% level of probability. The acquired grain yield in the 1st and 2nd years averaged as 1755.313 and 642.594 kg ha^{-1}. It seems the difference was originated from rainfall that occurred as 346.3 and 201.70 mm in the consecutive two years. Analysis of data (Table 1) revealed that interaction of tillage method and seed rate had a significant (p = 0.07) effect on grain yield. The grain yield resulted from TM2×SR3 (=1329 kg ha^{-1}) and TM1×SR2 (= 1291 kg ha^{-1}) had the fist position relative other yields.

Maximum and minimum yield acquired from TM2×SR3 (=1329 kg ha^{-1}) and TM2×SR2 (=1097 kg ha^{-1}). This finding is differ with those find by Rajput *et al.* (1989) and Bhatnager *et al.* (1991) that have reported maximum grain yield is obtained with increase in seed rate. The obtained yield from TM1×SR3, TM1×SR4 and TM2×SR4 and on the other hand TM1×SR1, TM2×SR1 and TM2×SR2 are in similar groups (Fig. 2). For acquiring the maximum yield minimum tillage with seed rate of 150 kg ha^{-1} or without mold board operation with seed rate of 125 kg ha^{-1} can be recommended.

Table 1: Mean squares and significance levels from the analysis of variance on grain yield and some yield components of dryland winter wheat

Source of variation	Degree of freedom	Grain yield	1000/grain weight	Spike length	Grains $spike^{-1}$	Spike (m^{-2})	Plant height
Replication	3	569858.057^{ns}	15.40^{ns}	0.89^{ns}	27.05^{ns}	4410.71^{ns}	175.96^{ns}
Year (Y)	1	19810288.27 **	1142.44**	59.10**	1356.91^{ns}	945.56^{ns}	13502.44**
Error	3	787322.77	16.80	1.27	34.96	3203.60	291.55
Tillage Methods (TM)	1	11262.52^{ns}	42.64*	0.01^{ns}	1.77^{ns}	8556.25**	0.39^{ns}
Y× TM	1	1113.89^{ns}	3.75^{ns}	0.10^{ns}	16.86^{ns}	430.56*	1.63^{ns}
Error	6	85160.74	4.85	0.48	14.66	3537.24	14.92
Seed Rate (SR)	3	82518.52*	3.39	3.35**	37.07**	83073.375	3.69
Y × SR	3	26818.06	8.87^{+}	0.87*	18.85*	5098.60	10.29
TM×SR	3	64637.31^{+}	2.32^{ns}	0.34^{ns}	7.02^{ns}	1610.04^{ns}	15.66^{ns}
Y×TM×SR	3	20879.27^{ns}	4.27^{ns}	0.11^{ns}	2.61^{ns}	3778.77^{ns}	17.89^{ns}
Error	36	25119.55	4.11	0.26	5.83	1881.85	14.69
Total	36						

**,*, + and ns: Significantly different at 1, 5 and 10% and nonsignificantly different at 10% level of probability, respectively

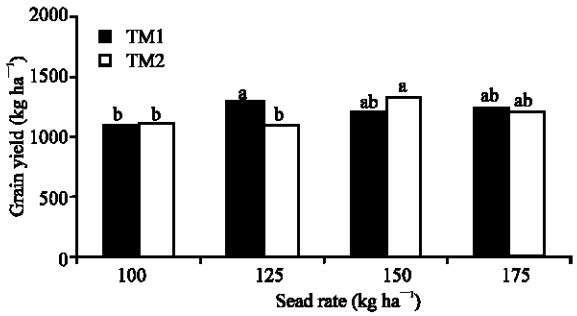

Fig. 2: Mean value of grain yield (kg ha^{-1}) versus applied seed rate (kg ha^{-1}) and soil tillage methods

A Weibull model were worked out for measured mean value of grain yield (kg ha^{-1}) versus applied seed rate (kg ha^{-1}) with applied soil tillage methods of TM1 and TM2, by multiple regression and the least squares procedure (Moghaddam, 1999). Acquired-models were as follow:

$$GY = 1262.46\text{-}206543.8 \text{ Exp } (-0.235 \text{ SR}^{0.745}) \quad (1)$$
$$R^2 = 0.99 \quad \text{for TM1}$$

$$GY = 1300.76\text{-}1198.48 \text{ Exp } (-0.008 \text{ SR}^{1.152}) \quad (2)$$
$$R^2 = 0.99 \quad \text{for TM2}$$

where GY, SR and TM are grain yield (kg ha^{-1}), applied seed rate (kg ha^{-1}) with soil tillage methods. TM1 and TM2 are treatments of without mold board and minimum tillage, respectively.

The R^2 of models indicating that fitted models explain all of the variability in the grain yields under conditions of conducted experiments in two cropping years. The grain yield from developed models compared with measured values and displayed in Fig. 3. The agreements were satisfactory. Bhatnager *et al.* (1991) reported that grain yield increased with the in crease in the seed rate from 100 to 200 kg ha^{-1}. This research finding is agreed with those find by Bhatnager *et al.* (1991).

The effect of tillage method and interaction of year with seed rate on 1000 grain weight is statistically significant at 5 and 10% level, respectively. Maximum and minimum 1000 grain weight acquired from plots applied Y1×SR1 (=37.88 g) and Y2×SR1 (= 27.45 g) treatments. The obtained 1000 grain weight from applying Y1×SR2 and Y2×SR3 and on the other hand SR1 to SR4 in the 2nd year are in similar groups (Fig. 4). This finding is consistent with those reported by Khan *et al.* (2002).

Analysis of data (Table 1) revealed that spike length was significantly (p = 0.05) affected by interaction of year and seed rate, while non significant effect was observed due tillage methods. Mean values indicated that maximum spike length were taken by those plots which ware sown in the 1997-98 year at the rate of 100 kg ha^{-1} while minimum spike length were recorded in plots that sown at the 175 kg ha^{-1} in the 2nd year. In general, plots sown in the 2nd year that grouped in similar class produced low

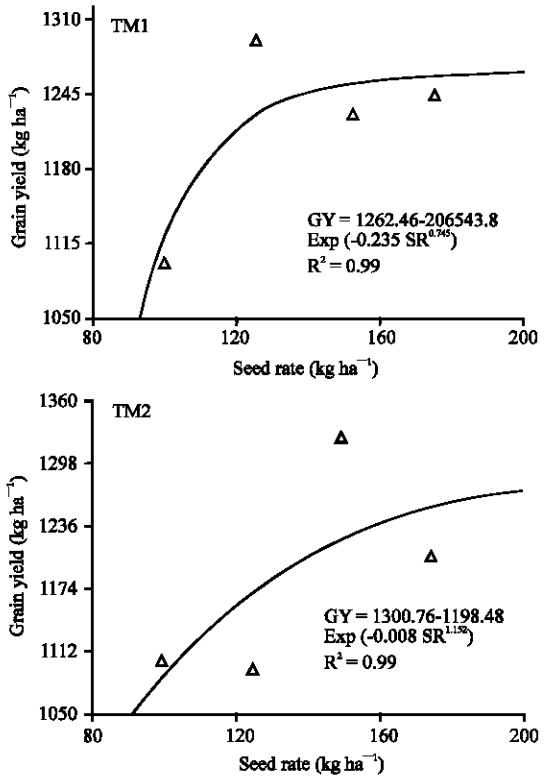

Fig. 3: Variation of mean value of grain yield (GY in kg ha^{-1}) versus applied seed rate (SR in kg ha^{-1}) with soil tillage methods. TM1 and TM2 are treatments of without mold board and minimum tillage, respectively

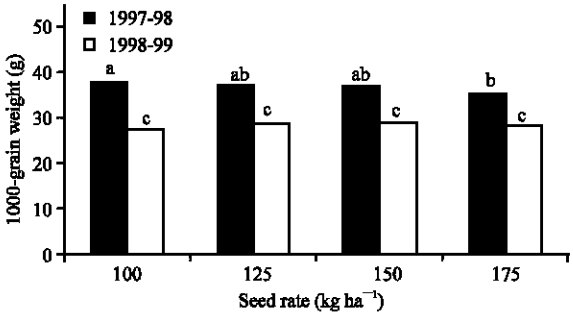

Fig. 4: Mean value of 1000 grain weight (g) versus applied seed rate during cropping years of 1997-98 and 1998-99

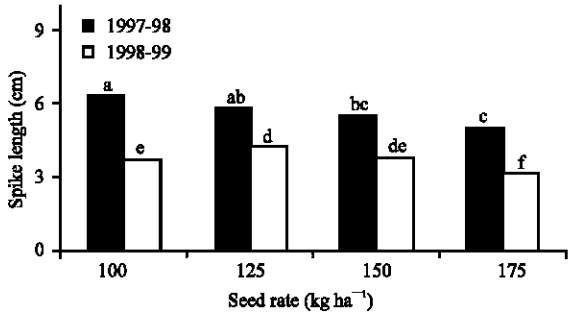

Fig. 5: Mean value of spike length (cm) versus applied seed rate (kg ha^{-1}) during cropping years of 1997-98 and 1998-99

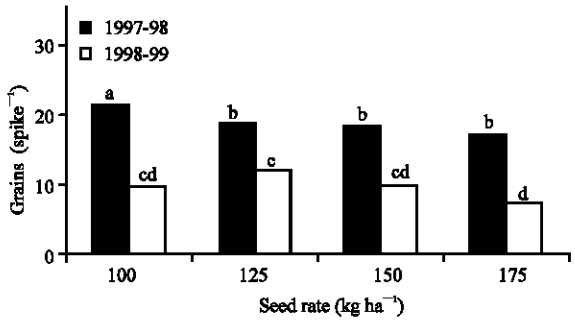

Fig. 6: Mean value of grains per spike versus applied seed rate (kg ha^{-1}) during cropping years of 1997-98 and 1998-99

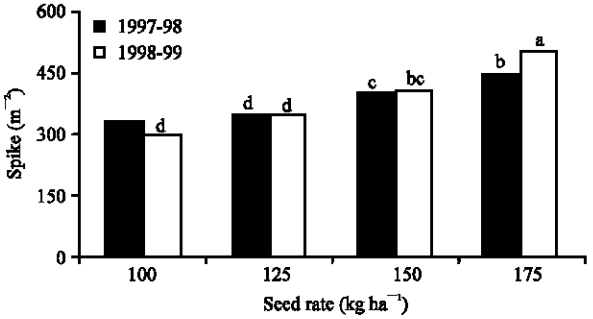

Fig. 7: Mean value of spike m^{-2} versus applied seed rate (kg ha^{-1}) during cropping years of 1997-98 and 1998-99

spike length relative plots sown in the 1st year. Spike lengths produced by plots sown at the rate of 125 and 150 kg ha^{-1} are in similar groups (Fig. 5)

Table 1 demonstrated that interaction of year and seed rate had a significant ($p \leq 0.05$) effect on grains $spike^{-1}$, while non significant effect was observed due tillage methods. Mean values indicated that, maximum grains $spike^{-1}$ (= 21.422) were taken by those plots which ware sown in the 1997-98 year at the rate of 100 kg ha^{-1} while minimum grains $spike^{-1}$ (= 7.296) were recorded in plots that sown at the 175 kg ha^{-1} in the 2nd year (Fig. 6). Grains $spike^{-1}$ produced by plots sown in the 1st year at the rate of 125, 150 and 175 kg ha^{-1} are in similar groups. Also, grains $spike^{-1}$ produced by plots sown in the 2nd year at the rate of 100 and 150 kg ha^{-1} are in similar groups. This result is consistent with those find by Khan *et al.* (2002).

Analysis of data (Table 1) revealed that interaction of year and seed rate had a significant ($p \leq 0.05$) effect on spike m^{-2}, while non significant effect was observed due tillage method. Mean values indicated that, maximum spike m^{-2} (= 507.6) were taken by those plots which were taken by those plots which ware sown in the 1998-99 year at the rate of 175 kg ha^{-1} while minimum grains $spike^{-1}$ (= 301.00) were recorded in plots that sown at the 100 kg ha^{-1} in the 2nd year. Spike m^{-2} produced by plots sown in the two consecutive years at the rate of 100 and 125 kg ha^{-1} are in similar groups (Fig. 7).

Analysis of data (Table 1) indicated that cropping years had a significant effect on plant height, while non significant effect was observed due tillage methods, seed rate and its interaction. Khan *et al.* (2002) found that seed rate had significant effect on plant height. The finding in the present study is differing with those reported by Khan *et al.* (2002). Mean values indicated that, maximum and minimum plant height were as 71.144 and 42.094 cm taken by those plots which were sown in the 1997-98 and 1998-99.

CONCLUSION

The influence of tillage methods and seed rates on grain yield and some yield components of dryland winter wheat were studied. The present study supports the following conclusions:

- Interaction of tillage method and seed rate had a significant effect on grain yield. Maximum grain yield obtained from TM2×SR3 with yield of 1329 kg ha^{-1}.
- The interaction of seed rate and cropping year was statistically significant on 1000 grain weight, spike length, grains $spike^{-1}$ and spike m^{-2}. It seems the cropping year effect is originated from rainfall that occurred as 346.3 and 201.70 mm in the consecutive two years.
- Maximum 1000 grain weight, spike length, grains $spike^{-1}$ and spike m^{-2} and plant height acquired as 37.88 g, 6.323 cm, 21.422 and 507.6, respectively.

ACKNOWLEDGMENTS

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