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Effect of tillage, seed rate and nitrogen levels on weeds and yield of wheat

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ABSTRACT

A field experiment was conducted to assess the effect of tillage, seed rate and nitrogen levels on weed and yield of wheat at College of Agriculture, S.K. Rajasthan Agricultural University, Bikaner during *Rabi* (winter) seasons of 2015-16 and 2016-17. It was laid out in a split plot design with three replications with six main plots comprising three levels of tillage (conventional, minimum and zero tillage) and two levels of seed rate (100 and 125 kg/ha) and four levels of nitrogen (80, 100, 120 and 140 kg N/ha) as sub-plots and comprising a total of 24 treatment combinations. The conventional tillage significantly increased the grain, straw and biological yields of wheat over zero and minimum tillage. Conventional tillage lowered the weed density and weed biomass as compared to zero and minimum tillage systems. Seed rate of 125 kg/ha and application of 120 kg N/ha significantly increased the grain, straw and biological yields over 100 kg/ha seed rate and 80 and 100 kg N.

Wheat (*Triticum aestivum* L.) is one of the most important staple food grain crops of India, which is the second leading producer of wheat next to China in the world (Usadadiya and Patel 2013). In India, wheat is cultivated in 30.0 million hectares with total production of 107 million tons; with average yield of 3400 kg/ha (IASRI 2019). The arguments in favour as well as against no tillage suggest that the tillage effects on crop yields need to be assessed in relation to management factors (Gajri *et al.* 2002) like fertilizers and seed rate. Tillage operations reduce the organic carbon, however no tillage with crop residue increased the soil organic carbon. Zero tillage favours proper management of crop residue which results in enhanced nutrient status.

Tillage strongly influences number and diversity of weed seed bank, and has overriding influence on weed shift (Akdbundu 1987). Type of tillage has profound effect on weed crop interference. Zero tillage had higher energy use efficiency than other tillage types. Nitrogen is a key nutrient in crop production and often an important limiting factor for the productivity of crops. Excessive use of N may increase input cost to farmers and environmental problems such as greenhouse gases emissions, leaching of NO_3^-, eutrophication, and reduce crop yield (Mali *et al.* 2001).

Seed rate is an important variable affecting yield and profit of crop production. Manipulation of seed rate has been emerged as an option for weed management particularly under conservation agriculture. High seed rate caused reduction in weed density and biomass in rice (Gill 2008). The information pertaining to influence of variable seed rate on weed dynamics of zero-till wheat for hot arid region is lacking. Weeds are competitive and adaptable to all adverse environments of the total annual loss of agricultural produce from various pests in India, which is about 45 per cent. (Yaduraju 2006). Wheat crop usually suffers from stress created by weeds through competition for water, nutrients, space and sunlight along with interference caused by releasing toxic substances into the rhizosphere (Rice 1984). This study was conducted to assess the effect of tillage, seed rate and nitrogen levels on weed and yield of wheat.

An experiment was conducted at the research farm, College of Agriculture, S.K. Rajasthan Agricultural University, Bikaner during *Rabi* seasons of 2015-16 and 2016-17. College of Agriculture is situated at 28.01^{0}N latitude, 73.22^{0}E longitude and at an altitude of 234.7m above mean sea level. The field experiment on wheat consisting of 3 tillage practices (conventional, minimum and zero tillage) and 2 levels of seed rate (100 and 125 kg/ha), thus 6 treatment combinations of tillage and seed rate were assigned to main plots and 4 levels of nitrogen (80, 100, 120 and 140 kg N/ha) to sub-plots, making total of 24 treatment combinations were tested in split plot design with three replications. The seed bed was prepared after pre-sowing irrigation depending on the main plot treatments. Two harrowing + two ploughings followed by planking were done as preparatory tillage for the conventional tillage. Whereas, for minimum tillage, one harrowing + one cultivator followed by planking were done during both the crop seasons. In zero tillage plots, no tillage operations were carried out during crop seasons. The calculated seed rate of 100 and 125 kg/ha were used as per treatment. The recommended dose of phosphorus (40 kg P/ha) and potassium (20 kg K/ha) was applied to wheat during both the seasons as basal. Whereas; nitrogen was applied as per treatment. The source of nitrogen, phosphorus and potassium were urea, DAP and muriate of potash (MOP), respectively.

Weed density and biomass were significantly affected owing to different tillage systems. There were 15.29 and 9.97 per cent reduction in total weed density at harvest in conventional tillage (CT) (**Table 1**) when compared with zero (ZT) and minimum tillage (MT), respectively. Greater weed density in zero tillage might be owing to presence of weed seeds to the upper soil layers (Singh *et al.* 2001). Maximum weed biomass was recorded in zero tillage which was 14.36 and 7.93% greater when compared with minimum and conventional tillage, respectively because weeds germinated along with the crop owing to preceding irrigation and accumulated maximum dry matter. The greater weed density and biomass reduction in conventional tillage might be due to the disturbance of soil with deep placement of weed seeds and frequent cutting of weed parts during tillage practices and superior establishment of crop. Similar findings were also stated by Pandey *et al.* (2005), Monsefi *et al.* (2013) and Upasani *et al.* (2014).

The higher grain and straw production were observed in CT compared to ZT and MT but the difference between ZT and MT were only marginal (**Table 2**). The rise in grain production of wheat under CT could be attributed to greater yield attributes whereas the rise in biological production was owing to greater dry matter production. To some extent, it could also attributed to superior soil environment (Idnani and Kumar 2012). This was probably owing to superior rooting induced by reduced soil strength in the upper 10-15 cm layer. ZT had the lowest production owing to greater weed intensity in the growing period. Soil compaction, higher weed density and improper seed coverage at sowing are the major factors which resulted in less yield under ZT. Limited covering the seeds with soil along with plant debris accretion a top soil surface, less seedling production owing to low seed germination and more growth of weedy plants may have caused this greater production loss (Unger 1978). Bahrani *et al.* (2002) also found that conventional tillage produced greater wheat grain productions as compared to zero and reduced tillage methods. Findings of Schllinger (2005) indicated that the use of no tillage compared with conventional tillage systems leads to a significant reduction in wheat, oats and barley production. Reduced seedling establishment and growth, exposure to heat at the end of season, weed density and changes in the physical properties of the soil are among reasons for the reduced grain production stated by different workers (Farooq *et al.* 2007). Also, others (Jug *et al.* 2011 and Wozniak 2013) demonstrated greater cereal production in the conventional system than in no-till system. According to De Vita *et al.* (2007) in areas with precipitation below 300 mm in the vegetative

Table 1. Effect of tillage, seed rate and nitrogen levels on weed density and total weed density of wheat

Treatment	Weed density (no./m^2)				Weed density (no./m^2)		Weed biomass (no./m^2)	
	Monocot		Dicot					
	30 DAS	At harvest	30 DAS	At harvest	30 DAS	At harvest	30 DAS	At harvest
Tillage								
ZT	0.61	1.41	5.53	14.17	6.14	15.57	10.27	27.78
MT	0.57	1.29	5.36	13.35	5.92	14.65	9.53	25.84
CT	0.50	1.17	4.68	12.01	5.18	13.19	8.81	23.79
LSD (p=0.05)	0.02	0.05	0.34	0.63	0.36	0.65	0.32	0.83
Seed rate (kg/ha)								
100	0.58	1.35	5.41	13.67	5.99	15.02	9.82	26.60
125	0.54	1.24	4.97	12.68	5.51	13.92	9.26	25.00
LSD (p=0.05)	0.02	0.04	0.28	0.51	0.29	0.53	0.26	0.67
Nitrogen levels (kg/ha)								
80	0.53	1.25	5.08	13.04	5.61	14.29	8.73	23.66
100	0.55	1.29	5.16	13.14	5.72	14.43	9.42	25.53
120	0.57	1.31	5.24	13.23	5.81	14.54	9.98	26.85
140	0.58	1.32	5.28	13.30	5.86	14.29	10.03	27.18
LSD (p=0.05)	NS	NS	NS	NS	NS	14.43	0.31	0.80

LSD- Least significant difference at the 5% level of significance; DAS - Days after sowing; ZT- Zero tillage; MT- Minimum tillage; CT- Conventional tillage

Table 2. Effect of tillage, seed rate and nitrogen levels on yields of wheat

Treatment	Grain yield (kg/ha)			Straw yield (kg/ha)			Biological yield (kg/ha)			Harvest index (%)		
	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled
Tillage												
ZT	2.95	2.84	2.90	4.09	4.04	4.06	7.04	6.88	6.96	41.9	41.3	41.6
MT	3.07	2.99	3.03	4.46	4.28	4.37	7.53	7.27	7.40	40.8	41.2	41.0
CT	3.21	3.11	3.16	4.77	4.45	4.61	7.98	7.55	7.77	40.2	41.2	40.7
LSD (p=0.05)	0.11	0.11	0.07	0.15	0.15	0.10	0.26	0.25	0.17	NS	NS	NS
Seed rate (kg/ha)												
100	3.03	2.93	2.98	4.35	4.14	4.25	7.38	7.07	7.23	41.1	41.5	41.3
125	3.13	3.03	3.08	4.53	4.37	4.45	7.65	7.40	7.52	40.9	41.0	40.9
LSD (p=0.05)	0.09	0.09	0.06	0.12	0.12	0.08	0.21	0.21	0.14	NS	NS	NS
Nitrogen levels (kg/ha)												
80	2.71	2.71	2.71	3.95	3.91	3.93	6.66	6.62	6.64	40.8	40.9	40.9
100	3.05	2.92	2.99	4.40	4.19	4.29	7.45	7.11	7.28	41.0	41.2	41.1
120	3.24	3.10	3.17	4.64	4.42	4.53	7.87	7.52	7.70	41.1	41.3	41.2
140	3.33	3.18	3.25	4.77	4.50	4.64	8.10	7.68	7.89	41.1	41.4	41.2
LSD (p=0.05)	0.14	0.10	0.09	0.19	0.13	0.11	0.32	0.23	0.19	NS	NS	NS

LSD, least significant difference at the 5% level of significance; DAS - Days after sowing

period superior growth are achieved with the ploughing than with the no-till system.

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