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Original Research Article

Effect of Seed Rate and Herbicides on Yield Attributes and Yield of Late Sown Wheat (*Triticum aestivum* L.)

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A B S T R A C T

An experiment was conducted at Crop Research Center of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh during Rabi seasons of 2012-13 and 2013-14 to assess the effect of seed rate and weed management practices on yield attribute and yield of late sown wheat (*Triticum aestivum* L.). The treatment consisted of three seed rate 100,125 and 150 kg ha^{-1} in main plot and six weed management practices *viz*. Sulfosulfuron 25 g ha^{-1}, Sulfosulfuron + Metsulfuron (30 + 2 g ha^{-1}), Clodinafop + Metsulfuron (60 + 4 g ha^{-1}), Fenoxaprop-p-ethyl + Metribuzin (120 + 210 g ha^{-1}), two hand weeding (120 and 40 DAS) and weedy check in sub-plots. The experiment was laid out in split plot design with three replications. Maximum number of spike m^{-2} was recorded at 150 kg ha^{-1} seed rate was significantly higher than 100 and 125 kg ha^{-1} seed rate. Other yield contributing characters like spike length, number of spikelets spike^{-1}, number of grain spike^{-1} and weight of 1000 grains were not influenced considerably, 100 kg ha^{-1} seed rate registered higher value of above yield contributing characters than 125 and 150 kg ha^{-1} seed rate. All weed management practices produced significantly higher no. of spike per unit area, no. of spikelets spike^{-1} and no. of grain spike^{-1} over weedy check while test weight and length of spike was found non-significant but numerically higher with weed management practices over weedy check. Two hand weeding produce maximum no. of spike m^{-2}, no. of spikelets spike^{-1} and no. of grain spike^{-1} which was at par with clodinofop + metsulfuron (60 + 4 g ha^{-1}) and sulfosulfuron + metsulfuron (30 + 2 g ha^{-1}. A seed rate of 150 kg ha^{-1} produced significantly higher grain, straw and biological yield than its lower level of 100 and 125 kg ha^{-1} seed rates. All weed management practices exception of fenoxaprop-p-ethyl + metribuzin (120 + 210 g ha^{-1}) had significant effect on grain, straw and biological yield, two hand weeding produce maximum grain, straw and biological yield which was at par with clodinofop + metsulfuron (60 + 4 g ha^{-1}) and sulfosulfuron + metsulfuron (30 + 2 g ha^{-1}). Fenoxaprop-p-ethyl + Metribuzin (120 + 210 g ha^{-1}) had Phytotoxic effect on wheat plants and produce minimum yield which was at par with weedy check.

Keywords

Seed rate, Herbicides, Hand weeding, Wheat, Yield attributes and yield

Introduction

Wheat is an important prime cereal crop among the food-grain is grown in an area of 29.65 m ha in India, with the production 93.5 million tonnes and average productivity 31.53 q ha^{-1} (FAO, 2013). Among several causes of low productivity in Uttar Pradesh,

adoption of rice-wheat rotation is one. Late transplanting of rice or use of long duration varieties in low land fields delays the sowing of wheat. The preceding crop like sugarcane, potato, paddy and toria etc. vacate the field late in season after normal sowing date of wheat and other factors enforce the crop be sown as much late as in the end of December and beginning of January.

Late sown crop experiences high temperature, declining relative humidity and hot dissecting winds in later stage of crop growth, particularly during grain filling stage. Exposure of crop to abnormally high temperature, desiccating winds and low relative humidity results in sever set back to grain filling and consequently the yields. Under such a situation, higher seed rate may affect the micro- environment and growth pattern of individual crop plant, leading to an overall increase in yield.

Yield potential and productivity of wheat under late sown condition is poor due to less exploitation of potentialities of the crop. Emergence of seedling due to low temperature curtailing the periods from emergence to maturity in late sown condition optimum plant population can be maintain by optimum seed rate (Singh and Singh, 1987).

Low grain yield could be occurred due to inappropriate planting method, seed rate and crop management. Optimum seed rate is most important for maximum yield of crop. If very high seed rate is used, plant population will be more and there will be competition among plants for water, nutrients and sunlight resulting in low quality and low yield, if less seed rate is used yield will be less due to lesser number of plants unit^{-1} area (Attarde and Khuspe, 1989).

Late sowing of wheat tends to reduce germination count due to low temperature at germination and tillers unit^{-1} area because of rise in temperature during tillering phase of the crop and consequently increase in the temperature at milking stage of the crop is the major threat affecting the productivity adversely. To mitigate the deleterious effect of delayed sowing, increasing seed rate will be a viable and economic option to compensate the reduction germination count and number of tillers per unit area. Seed rate plays a vital role for optimum plant densities which is a pre-requisite for increased seed yield, it influences the yield and yield attributes of wheat (Singh and Singh, 1987). Higher seed rate produces more plants in unit area resulting the higher yield and production cost, on the other hand, lower seed rate may reduce the yield drastically. A high seed rate is required to secure an optimum and effective plant population for better yield and it is also expected to reduce weed growth, weed density and dry matter are supposed to be suppressed substantially through increasing plant populations (Zindahl,1999). Thus variation in seed rate and weed control method instruct to influence growth and yield of wheat. Seed rate 140 kg ha^{-1} gave significantly higher yield than the 100 and 120 kg ha^{-1} but at par with 160 kg ha^{-1}, (Bibi *et al.*, 2008).

Weeds are also considered as major constraints in wheat cultivation under late sown condition. Increasing population of canary grass (*Phalaris minor retz*.) with broad leaf weeds causing substantial yield loss in rice-wheat cropping system, yield reduction due to weeds is 38-42% (Bharat and Kachroo, 2007) or even more. Due to severe infestation of *Phalaris minor* significant reduction in wheat yield ranging from 18-73% has been reported by Pandey and Verma. (2004).

The problem of complex weed flora in wheat was successfully solved through sequential application of Clodinafop, Fenoxaprop or Sulfosulfuron at 30-35 DAS fb 2, 4-D, Metsulfuron or Carfentrazone. But it required two separate operations for aforesaid herbicide applications particularly in case of 2, 4-D and Metsulfuron which cause antagonistic effect on the efficacy of Clodinafop and Fenoxaprop (Yadav *et al.*, 2002) and thus, adds to cost. Another herbicide as premix formulation of Sulfosulfuron + Metsulfuron was recommended against complex weed flora and it did very well but residual toxicity of this herbicide on sensitive succeeding crops (Sorghum and Maize) in rotation put a question mark on its wide acceptability. Likewise, Metsulfuron +Iodosulfuron recommended against complex weed flora was reported to cause phyotoxicity not only to wheat crop but also to succeeding sorghum crop.

Keeping these facts in view, the present investigation was under taken to study the effect of seed rate and herbicides on yield attribute and yield of late sown wheat (*Triticum aestivum* L.).

Materials and Methods

A field experiment was conducted during Rabi seasons of 2012-13 and 2013-14 at Crop Research Center of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, belong to North Western Plain Zone in irrigated ecosystem. Temperature and rainfall etc. data for the growing period have depicted in Fig.1 &2.

Soil was sandy loam in texture having pH 7.81 and 8.21, organic carbon 0.43-0.41% and available NPK was 178.6 and 175; 17.4 and 16.5; 25.5 and 250.4 kg ha^{-1}. The treatment comprised of three seed rates (100, 125 and 150 kg ha^{-1}) in main- plots and five weed management practices, *viz*. Sulfosulfuron 25 g ha^{-1}, Sulfosulfuron + Metsulfuron (30 + 2 g ha^{-1}), Clodinafop + Metsulfuron (60 + 4 g ha^{-1}), Fenoxaprop-p-ethyl + Metribuzin (120 + 210 g ha^{-1}), two hand weeding (120 and 40 DAS) and weedy check in sub-plots. The experiment was laid out in split plot design with three replications. A promising wheat variety PBW-590 recommended for late sown condition for NWPZ of wheat was sown on 08 and 09 December during 2012-13 and 2013-14, respectively. A uniform dose of 120 kg N, 60 kg P and 40 kg K ha^{-1} was applied in the form of Urea, Di-ammonium phosphate and Muriate of potash in all the plots. One-third dose of nitrogen and full dose of phosphorus and potassium were applied as basal and remaining two-thirds of nitrogen was applied through urea as top dressing after first irrigation and panicle initiation stages. First irrigation was given at crown root initial stage after that crop was irrigated 20-25 days interval to avoid any kind of water stress. Herbicides were applied as post emergence *i.e.* 30 DAS with the help of hand-operated Knapsack sprayer, fitted with flat fan nozzle with 250 litter ha^{-1}water. First hand weeding was done at 20 and second at 40 DAS.

Results and Discussion

Yield attributes

The yield of a crop depends upon the source relationship and it's the cumulative function of various growth parameters and yield attributing components *viz*., number of effective tillers, grains $spike^{-1}$, length of spike and test weight (1000 grain weight). Any factor affecting there parameters ultimately effects the biological and economic yield of a crop. Source

components may be number of leaves, number of tillers and dry matter of the plants before anthesis and sink components viz., number of spikelets spike^{-1}, no. of spike m^{-2}, length of spike, no. of grain spike^{-1} and test weight. Final yield of wheat is the function of no. of spike m^{-2}, no. of grain spike^{-1} and 1000 grain weight, grain yield, being the economic objective of the producers, assumes a vital importance and as such after basis of the comparison values of a particular treatment with other

No. of spike m^{-2} had significant effect on varying seed rate, maximum no. of spike m^{-2} was recorded at 150 kg ha^{-1} seed rate was significantly higher than 100 and 125 kg ha^{-1} seed rate. This might be due to higher no. of tillers recorded at 150 kg ha^{-1} seed rate on all stages of crop growth, similar results observed by Bibi *et al.* (2008) and Iqbal *et al.* (2010). Other yield contributing characters like length spike, no. of spikelets spike^{-1}, no. of grain spike^{-1} and weight of 1000 grains were not influenced considerably, 100 kg ha^{-1} seed rate registered higher value of above yield contributing characters than 125 and 150 kg ha^{-1} seed rate. This might be due to less competition for light, space, moisture and nutrient Khan *et al*. (2002) have also recorded higher values of above yield contributing characters under the effect of lower seed rate in wheat. Grain yield of wheat is dependent upon the number of spike^{-1} unit area, no. of grain spike^{-1} and 1000 grain weight. The combined product of these components gave the grain yield of wheat. The yield of wheat was reduced heavily due to uncontrolled weed. All weed management practices produced significantly higher no. of spike per unit area, no. of spikelets spike^{-1} and no. of grain spike^{-1} over weedy check while test weight and length of spike was found non-significant but numerically higher with weed management practices over weedy check. Two hand weeding produce maximum no. of spike ha^{-1}, no. of spikelets spike^{-1} and no. of grain spike^{-1} was at par with clodinofop + metsulfuron (60 + 4 g ha^{-1}) and sulfosulfuron + metsulfuron (30 + 2 g ha^{-1}) Table 1. This might be due to effective weed control of these treatments. Almost similar result reported by Malik *et al*. (2013) and Tomar and Tomar (2014).

Fig.1 Weekly weather condition during the *rabi*, 2012-13

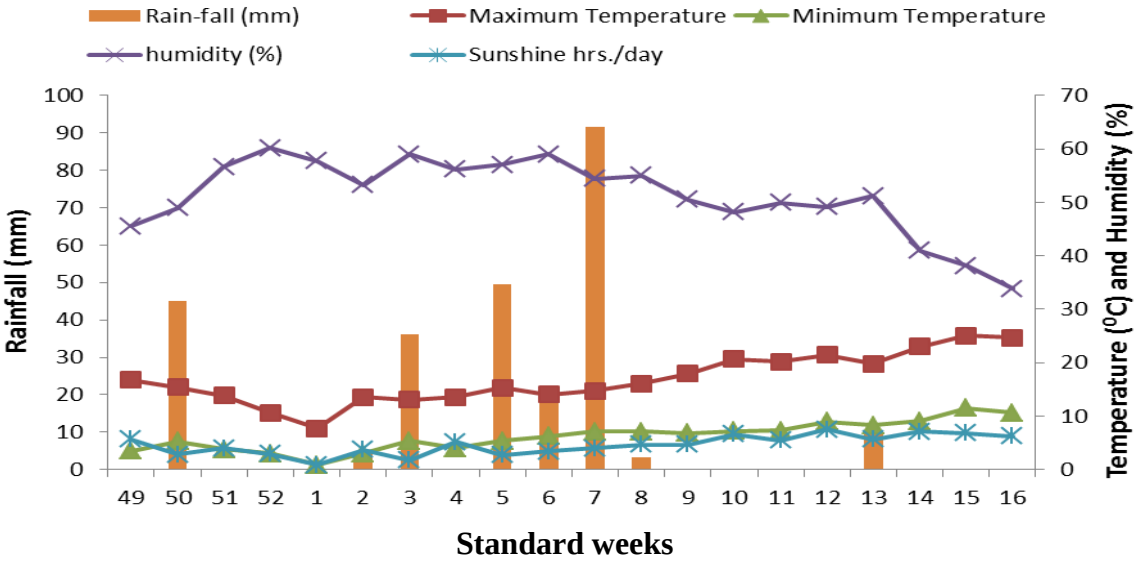


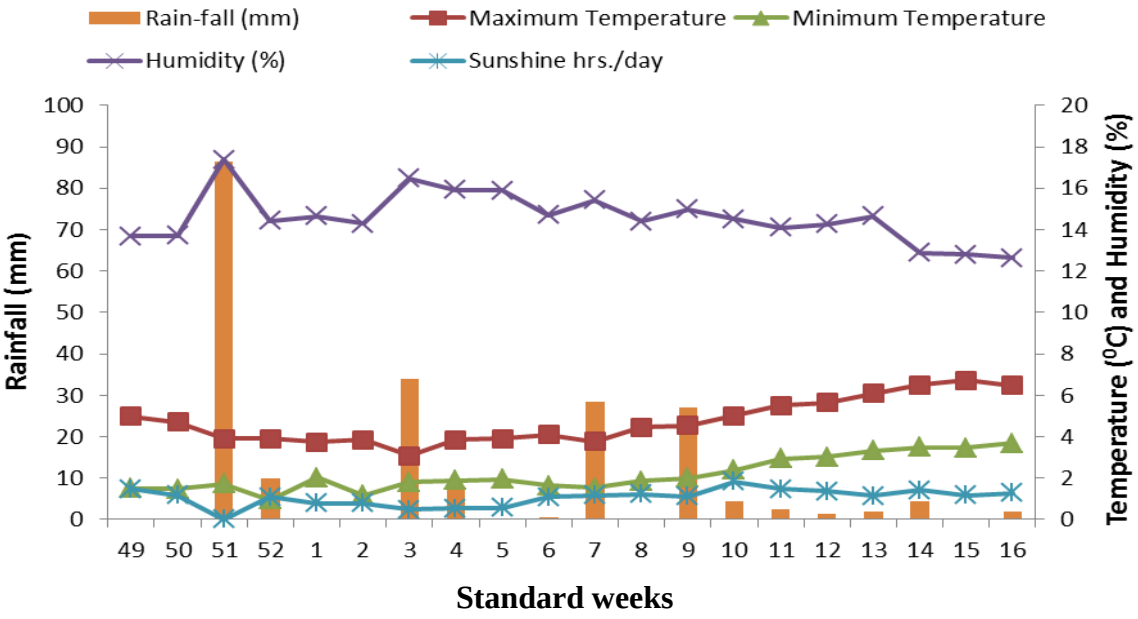
Table.1 Yield attributes of wheat as influenced by seed rate and weed management practices

Treatment	No. of spike m^{-2}		Spike length (cm)		No of spikelets $spike^{-1}$		No. of grains $spike^{-1}$		Test weight (g)	
	2012-13	2013-14	2012-13	2013-14	2012-13	2013-14	2012-13	2013-14	2012-13	2013-14
Seed rate										
100 Kg ha^{-1}	299.06	300.61	9.28	9.15	15.16	15.12	35.62	35.53	34.09	33.34
125 Kg ha^{-1}	326.22	321.78	9.20	9.04	15.11	15.05	35.59	35.31	34.04	33.19
150 Kg ha^{-1}	344.06	340.72	8.96	8.96	14.89	15.00	35.53	35.20	33.93	33.26
SEm(±)	1.66	1.47	0.11	0.12	0.21	0.22	0.34	0.32	0.15	0.16
C.D. (P=0.05)	6.67	5.92	NS	NS	NS	NS	NS	NS	NS	NS
Weed management practices										
Sulfosulfuron @ 25 g ha^{-1}	327.00	323.78	9.03	8.87	14.89	15.33	35.55	34.92	34.08	33.37
Sulfosulfuron+Metsulfuron @ 30 g +2 g ha^{-1}	342.11	334.45	9.26	9.07	15.78	15.67	37.55	37.54	34.08	33.38
Clodinafop+ Metsulfuron @ 60 g +4 g ha^{-1}	344.11	338.38	9.37	9.17	16.11	16.33	38.23	37.83	34.35	33.46
Fenoxaprop+ Metribuzin @ 120 g +210 g ha^{-1}	291.33	290.67	8.86	8.84	14.33	13.56	32.08	31.78	33.67	32.98
Two hand weeding (20 & 40 DAS)	346.11	339.56	9.56	9.58	16.11	16.56	38.30	38.33	34.37	33.77
Weedy Check	291.00	290.45	8.85	8.82	12.89	13.00	32.03	31.67	33.57	32.62
SEm(±)	3.80	3.54	0.38	0.33	0.51	0.49	1.11	1.77	0.34	0.45
C.D. (P=0.05)	11.02	10.28	NS	NS	1.47	1.42	3.23	3.19	NS	NS

Table.2 Effect of seed rate and weed management practices on Grain, Straw, Biological yield (q/ha) and harvest index of wheat

Treatment	Grain yield (q ha^{-1})		Straw yield (q ha^{-1})		Biological yield (q ha^{-1})		Harvest index (%)	
	2012-13	2013-14	2012-13	2013-14	2012-13	2013-14	2012-13	2013-14
Seed rate								
100 Kg ha^{-1}	36.65	35.72	55.36	53.76	92.01	89.48	39.86	39.96
125 Kg ha^{-1}	39.64	38.02	60.53	57.52	100.34	95.84	39.71	39.66
150 Kg ha^{-1}	41.75	39.91	63.98	60.71	105.73	100.62	39.49	39.68
SEm(±)	0.49	0.29	0.57	0.72	1.05	1.00	0.14	0.09
C.D. (P=0.05)	1.99	1.16	2.29	2.89	4.23	4.04	NS	NS
Weed management practices								
Sulfosulfuron @ 25 g ha^{-1}	39.11	36.97	59.68	57.49	98.8	94.39	39.61	39.13
Sulfosulfuron+ Metsulfuron @ 30 g +2 g ha^{-1}	43.46	41.78	66.11	62.43	109.91	104.88	39.84	39.83
Clodinafop+ Metsulfuron @ 60 g + 4 g ha^{-1}	45.13	42.8	68.67	64.89	113.8	107.55	39.65	39.80
Fenoxaprop+ Metribuzin @ 120 g +210 g ha^{-1}	31.57	31.05	47.01	46.55	78.57	77.60	40.18	40.15
Two hand weeding (20 & 40 DAS)	45.54	43.92	69.32	66.72	114.86	110.64	39.64	39.69
Weedy Check	31.28	31.02	46.93	46.54	78.21	77.56	40.00	39.99
SEm(±)	1.17	1.11	1.75	1.79	3.37	2.99	0.36	0.20
C.D. (P=0.05)	3.39	3.23	5.09	5.18	9.77	8.67	NS	0.58

Fig.2 Weekly weather condition during the *rabi*, 2013-14



In conclusion, based on two year experiments conducted at Crop Research Center of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut (U. P.) A seed rate of 150 kg ha^{-1} produced significantly higher grain, straw and biological yield than its lower level of 100 and 125 kg ha^{-1} seed rates. Among weed management practices exception of fenoxaprop-p-ethyl + metribuzin (120 + 210 g ha^{-1}) had significant effect on grain, straw and biological yield, two hand weeding produce maximum grain, straw and biological yield which was at par with clodinofop + metsulfuron (60 + 4 g ha^{-1}) and sulfosulfuron + metsulfuron (30 + 2 g ha^{-1}). Fenoxaprop-p-ethyl + Metribuzin (120 + 210 g ha^{-1}) had Phytotoxic effect on wheat plants and produce minimum yield which was at par with weedy check. It had been concluded that sowing with 150 kg ha^{-1} seed rate and application of herbicide Clodinafop + Metsulfuron (60 + 4 g ha^{-1}) or Sulfosulfuron + metsulfuron (30 + 2 g ha^{-1}) found better for higher yield of wheat.

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