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Improving Barley (Hordeum Vulgare L.) Productivity Through Integrated Nutrient Management under Different Dates of Sowing

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Abstract

A field experiment was carried out during rabi season of 2017-18 entitled "Improving barley productivity through integrated nurtient management under different dates of sowing" at Agricultural Research Farm R.B.S. College, Bichpuri, Agra. The variables involved in this study were three dates of sowing-timely (Nov. 10)-D_1 , Late (Nov. 25)-D_2 Vary Late (Dec.10)-D_3 and 6 fertility treatments in barley (Recommended does of fertilizer (RDF)-T_1, RDF + FYM @5 t ha^{-1}-T_2, RDF + mulch @6t ha^{-1}-T_3, RDF + FYM @5 t ha^{-1}+ mulch@6t ha^{-1}-T_4, RDF + FYM @5 t ha^{-1}+ mulch@6t ha^{-1} +spray of $ZnSO_4$@5% -T_5, RDF + FYM @5 t ha^{-1}+ mulch@6t ha^{-1} +2spray of KCl@5% (Flag leaf and post anthesis)-T_6. Thus in all 18 treatment combinations were compared in a "Split plot design" having dates of sowing in main plots and additives in sub-plot with four replications. Concluded that timely sown crop (Nov. 10) resulted in significantly higher grain yield by 8.91 and 20.51 per cent, respectively than late (Nov. 25) and very late (Dec. 10) date of sowing. Late sowing (Nov. 25) also produced appreciably higher grain yeild by 10.62 per cent than very late (Dec. 10) date of sowing. The maximum grain yield was obtained with the application of recommended dose of fertilizer (60+30+20 kgNPK ha^{-1} along with FYM@5t ha^{-1} + mulch @ 6t ha^{-1} + Spray of $ZnSO_4$@5% in all the fertility treatments. The highest net income of Rs. 6081 ha^{-1} was obtained with normal date of sowing.

Introduction

At present, the real challenge in Indian agriculture is to produce more quality food for burgeoning population from the same land and water resources, besides sustaining soil health and environmental quality. India alone needs to produce additional 64 million tonnes of food over the next decade to achieve targeted 294 million tonnes by 2020.

Although a minor crop, barley play an important role in enhancing the food security of the country. But the productivity of this crop in India is very low as compared to that of many other countries, mainly due to use of low inputs and improper agronomic practices.

The major constraints limiting barley's production are cultivation in poor and marginal soils with poor native soil fertility, rainfed cultivation with recurring drought a common feature, negligible coverage under important varities, application of practically non cash inputs like dates of sowing, use of high yielding varieties, dearth of a remunerative market for production because of the lack of appreciation about the nutritive value of this crop and changes in the life style of the population.

The dates of sowing trial conducted during past 25 years under AICWIP showed that delay in barley sowing from normal to late decrease the yield by 34.2 kg ha^{-1}/day or 19.8 per cent in NWPZ. Similarly for late sown varieties, delay in barley sowing from late to very late lead to decline in the grain yield. The efficient use of nutrients within crop production

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systems has been in focus for several decades. The application of manures to soil provides potential benefits including improving the fertility, soil structure, water holding capacity of soil, increasing soil organic matter and reducing the amount of synthetic fertilizers needed. For crop production (**Choudhary, et al., 2013).** The present investigation was carried out to identify the suitability of fertilizers, manures along with foliar spray of $ZnSO_4$ and KCl with different dates of sowing of barley.

Material and Methods

The experiment was conducted under department of Agronomy at Agricultural Research Farm, R.B.S. College, Bichpuri, Agra. The climate of this site is semi-arid with average rainfall 650mm about 80% of which is received during July-September. The soil at this site is well drained sandy loam in texture with pH 8.24 . The soil was low in available nitrogen (190.20 kg ha^{-1}) medium in available phosphorus (28.30 kg P_2O_5 ha^{-1}) and rich in Potash (290.0 kg K_2O ha^{-1}). The variables involved in this study were three dates of sowing such as timely (Nov. 10)-D_1, Late Nov. 25)-D_2, and very late Dec-10)-D_3 and 6 fertility levels in barley Recommended dose of fertilizer (RDF)-T_1, RDF + FYM @5 t ha^{-1}-T_2, RDF + mulch @6t ha^{-1}-T_3, RDF + FYM @5 t ha^{-1}+ mulch @6t ha^{-1}-T_4, RDF + FYM @5 t ha^{-1}+ mulch @6t ha^{-1} +spray of $ZnSO_4$ @5% -T_5, RDF + FYM @5 t ha^{-1}+ mulch @6t ha^{-1} +2 spray of KCl@5% (Flag leaf and post anthesis)-T_6. Fertilizers were applied as per treatments. The recommended dose of fertilizer for barley was taken as 60 kg N, 30 kg P_2O_5 and 20 kg K_2O ha^{-1}. Full dose of P and K and half dose of N were applied as basal to the respective plots as per treatments. The remaining half dose of N was applied at the time of first irrigation. Thus in all 18 treatment combinations were compared in a "Split Plot Design" having dates of sowing in main plots and fertility levels in sub-plots with four replications. The data relating to each character were analysed as per the procedure of analysis of variance as suggested by Panse and Sukhatme (1985). Economics of different treatments was worked out on the basis of input and output on the prevailing market prices and B : C ratio was calculated.

Results and Discussion :

Effect on dry matter accumulation

The dry matter accumulation / 25 cm length was significantly influenced by various dates of sowings and combinations of fertilizers, organic manners and foliar spray of $ZnSO_4$ and KCl (Table 1).

Table 1 : Effect of date of sowing and intergrated use of fertilizers, organic manures mulch, with foliar spray of Zinc Sulphate ($ZnSO_4$) and Potassium Chloride (KCl) on dry matter accumulation (DMA)/25 cm length and yield attributes of barley

Treatments	DMA at harvest	Spike length (cm)	No. of spikeled $spike^{-1}$	No. of fertile spikelets $spike^{-1}$	No. of grains $spike^{-1}$	Grain weight (g) $spike^{-1}$	1000-grain weight (g)
Date of Sowing							
D_1 –Timely (Nov. 10)	120.98	6.78	51.78	48.31	34.62	2.28	50.26
D_2 –Late (Nov. 25)	113.42	6.43	45.39	43.81	32.94	2.04	48.18

D_3 –Very late (Dec. 10)	106.25	6.12	41.11	35.58	31.32	1.83	46.19
SEM±	1.86	0.08	1.13	1.63	0.45	0.06	0.52
CD (P = 0.05)	6.42	0.28	3.91	5.64	1.55	0.20	1.78
Fertilizers, Organic Manure, Mulch and Foliar Spray							
T_1 – (RDF)	108.18	6.36	41.69	39.51	30.37	2.01	45.30
T_2 –RDF + FYM @5 t ha^{-1}	109.27	6.37	43.84	40.98	31.38	2.03	46.32
T_3 –RDF + mulch @6t ha^{-1}	110.16	6.36	46.30	40.79	31.36	2.01	47.26
T_4 –RDF + FYM @5t ha^{-1}+ mulch@6t ha^{-1}	115.90	6.54	47.03	42.12	33.55	2.15	49.06
T_5 –RDF + FYM @5t ha^{-1}+ mulch@6t ha^{-1} +spray of $ZnSO_4$@5%	119.88	6.53	50.39	48.00	36.55	2.44	50.70
T_6 –RDF + FYM @5t ha^{-1}+ mulch@6t ha^{-1} +2 spray of KCl@5% at Flag leaf and post anthesis)	117.91	6.54	47.43	43.95	34.56	2.24	50.62
SEM±	1.81	0.07	1.08	1.55	0.43	0.05	0.50
CD (P = 0.05)	5.15	0.20	3.06	4.41	1.22	0.14	1.42

Effect of dates of sowing was statistically significant on dry matter accumulation in plants of 25cm row length at all the stages of crop growth. The dry matter accumulation was significantly increased with timely sown crop (Nov. 10) when compared with late (Nov. 25) and very late (Dec. 10) dates of sowing. At almost all the stages of crop growth. Application of RDF + FYM @ 5 t ha^{-1} + mulch @ 6t ha^{-1} + sprays of $ZnSO_4$ @ 5% (T_5) did not differ significantly with application of RDF + FYM @ 6t ha^{-1} + Mulch @ 6t ha^{-1} + 2 sprays of KCl @ 5% at Flag leaf and post anthesis (T_6) but produced significantly higher dry matter accumulation in plant as compared to rest of the treatments under study. The plants in timely sowing dates are benefited to soil moisture and nutrients from the soil for longer period over the plant in late and very late dates of sowing. Girothia et al. (1987), Sarkar and Trofoder (1992) and Kumar, et al. (2003) also found similar results.

Table 2 : Effect of date of sowing and intergrated use of fertilizers, organic manures, mulch with foliar spray of Zinc Sulphate ($ZnSO_4$) and Potassium Chloride (KCl) on yield and economics of barley

Treatments	Biological yield (t ha^{-1})	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)	B : C ratio
Date of Sowing					
D_1 –Timely (Nov. 10)	11.55	4.98	6.56	43.20	2.71
D_2 –Late (Nov. 25)	10.67	4.58	6.10	42.91	2.66
D_3 –Very late (Dec. 10)	9.72	4.14	5.58	42.61	2.43
SEM±	1.68	0.93	0.88	0.58	0.09
CD (P = 0.05)	5.84	3.22	3.06	NS	0.25
Fertilizers, Organic Manure, Mulch and Foliar Spray					
T_1 – (RDF)	9.93	4.19	5.73	42.23	2.78
T_2 –RDF + FYM @5 t ha^{-1}	10.23	4.34	5.88	42.42	2.66
T_3 –RDF + mulch @6t ha^{-1}	10.28	4.42	5.87	42.94	2.75
T_4 –RDF + FYM @5t ha^{-1}+ mulch@6t ha^{-1}	10.88	4.69	6.19	43.12	2.56
T_5 –RDF + FYM @5t ha^{-1}+ mulch@6t ha^{-1} +spray of $ZnSO_4$@5%	11.40	5.10	6.42	43.81	2.71
T_6 –RDF + FYM @5t ha^{-1}+ mulch@6t ha^{-1} +2 spray of KCl@5% at Flag leaf and post anthesis)	11.16	4.79	6.37	42.90	2.69
SEM±	1.10	0.99	0.74	0.56	0.02
CD (P = 0.05)	3.14	2.82	2.12	NS	0.06

The favourable effect of organic manure and mulch on growth was on account of improved photosynthetically active leaf area for longer period during vegetative and reproductive phases, leading to more absorption and utilization of radient evergy, which ultimately resulted in higher dry matter accumulation. Significant increase in dry matter accumulation in 25cm and length was observed with foliar sprays of $ZnSO_4$ and KCl. This might be due to readily available $ZnSO_4$ and KCl at early and the critical stages of plant growth that facilitated maximum plant grow the Sakal et al. (1985) also held similar view.

Effect on yield attributes :

Different yield attributes of barley were significantly influenced by various dates of sowing and organic manure treatments (Table 1). The length of spike, number of spikelets per spike, number of fertile spikelets per spike, number of grains per spike, grain weight (g) per spike and 1000-grain weight (g) were increased significantly with timely sown crop (Nov. 10) than late (Nov. 25) and very late (Dec. 10) dates of sowing. The 1000-grain weight reduced with every delay in sowing dates from timely sown crop, however, the variation in 1000 grain weight due to timely sown and late sown was marginal and could not reach the level of significance but both the dates of sowing produced appreciably higher

1000-grain weight than very late date of seeding, **Mishra et al. (2003)**, Singh & Sharma (2006) and Li. et al. (2008) also held similar results. Various yield contributing characters were influenced significantly due to different fertility treatments. The application of FYM@5t ha^{-1} + mulch 6t ha^{-1} + Spray of $ZnSO_4$ @ 5% along with RDF (T_5) proved its significant superiority over rest of the fertility treatments and RDF applied alone.

Effect on yield and Harvest Index

The biological, grain and straw yield was also significantly affected due to different dates of sowing. Timely sown crop (Nov. 10) increased appreciably biological, grain and straw yield ha^{-1} over late (Nov. 25) and very late (Dec. 10) dates of seeding. The highest harvest index was recorded with timely sown crop and it was statistically at par with late and very late dates of seeding. Similarly biological, grain and straw yields were also increased due to various fertility treatments along with RDF over RDF applied alone. Application of FYM @ 5t ha^{-1} + mulch @6t ha^{-1} + spray of $ZnSO_4$ @ 5% + RDF and RDF + FYM@5t ha^{-1} + mulch @ 6t ha^{-1} + 2 Sprays of KCl @ 5% at flag leaf and post anthesis were at par but produced significantly higher grain yield as compared to all other fertility treatments and RDF alone, tested in this study. These results are in close proximity to the results noted by **Shah and Akmal (2001) and Kim et al. (2009).**

Economics

The highest net income was obtained from normal sown crop (Nov. 10) with the application of RDF along with FYM@5t ha^{-1} + mulch 6t ha^{-1} + spray of $ZnSO_4$ @ 5% while the B/C ratio was highest in case of crop sown at normal date of sowing (Nov. 10) with the application of recommended doses of fertilizers only. This might be due to low cost of cultivation.

Based on the results of the study, it can be inferred that barley crop sown at normal date of sowing (Nov. 10) fertilized with recommended dose of fertilizer (60 + 30 + 20 kg NPK ha^{-1}) along with FYM @5t ha^{-1} +mulch 6t ha^{-1} + spray of $ZnSO_4$@5% in barley variety BH-946 is advisable for higher productivity and profitability in barley.

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