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PERFORMANCE OF DUAL PURPOSE BARLEY (*HORDEUM VULGARE* L.) VARIETIES FOR GREEN FODDER AND SUBSEQUENT PRODUCTIVITY UNDER VARYING SEED RATE AND FERTILITY MANAGEMENT

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SUMMARY

In order to select best suited dual purpose barley variety, to work out optimum fertilizer levels and seed rate, a field experiment was conducted during *rabi* 2009-10. The treatment consisted combinations of two dual purpose varieties (RD 2552 and RD 2035), three seed rate (100, 125 and 150 kg/ ha) and three fertilizer levels (100 per cent RDF: 60 + 20 kg N + P_2O_5/ha, 125 per cent RDF and 150 per cent RDF). Green fodder yield and growth character of dual purpose barley variety RD 2552 before and after green fodder cutting was significantly higher over RD 2035. The variety had higher grain and straw yield, accumulated maximum N and P in green fodder, grain and straw and total uptake compared to variety RD 2035. This manifested in additional net returns of Rs.4958 ha^{-1} over RD 2035 and increased B:C ratio from 1.4 to 1.7. Application of 125 kg seed/ ha proved best and economically profitable over 100 kg seed/ha. The results revealed that application of 125 and 150 per cent RDF improved growth parameters, yield attributing parameters, grain, straw yield, N and P uptake over 100 per cent RDF. Protein content increased and crude fibre content of green fodder decreased with increasing fertility levels. However, TDN remains stable under varying fertility levels. With highest net returns and B:C ratio application of 125 per cent RDF proved most economically benificial.

Key words : Dual purpose barley, seed rate and fertility levels

Barley (*Hordeum vulgare* L.) is a valuable crop because it is used for food, processed food and feed for live stock. Besides these conventional uses, it is an important industrial crop. In recent past, India has made an impressive progress in achieving self sufficiency in food grain production by elevating productivity of several crops. However, forage production for livestock is limited. In India, Rajasthan ranks first in barley area, where the crop occupies 2.87 lac ha acreage with the production of 8.78 lac tonnes at an average productivity of 30.6 q/ha (Anonymous, 2010). Barley possesses high total biomass, thus the small and marginal farmers of our country used green barley fodder as feed for milch animals. Looking to it high total biomass and salt tolerance nature, there has been an increasing interest in exploiting barley as a dual purpose cereal which can permit forage production in early season in addition to the grain yield later on (Yadav *et al.*, 2003 and Anonymous, 2010). Adequate seed rate, cutting schedule and mineral fertilization is considered to be one of the most important pre-requisite for realizing higher green fodder as well as grain yields (Thomson *et al.*, 2009). Considering these facts and paucity of research findings on these aspects experiment was conducted during **rabi** 2009-10.

METHODS AND MATERIALS

The field experiment was carried out during **rabi** 2009-10 at the Instructional farm, Rajasthan college of Agriculture, Udaipur, (Rajasthan). The soil of the experimental site was clay loam having pH 7.5, organic carbon 0.66, available nitrogen 268.4 kg/ha, available phosphorus 19.5 kg/ha, available potassium 365.5 kg/ha in the plough layer. The treatment consisted two dual purpose varieties (RD 2552 and RD 2035), three seed rate (100, 125 and 150 kg seed/ha) and three fertility levels (100 per cent RDF: 60 + 20 kg N + P_2O_5/ha, 125 per cent RDF: 75 + 25 kg N + P_2O_5/ha and 150 per cent RDF: 90 + 30 kg N+P_2O_5/ha) were tested in factorial randomized block design and replicated thrice. The dual

purpose barley varieties RD 2035 and RD 2552 were notified in 1994 and1999, respectively as dual purpose varieties (Verma and Sarkar, 2010). The crop was sown manually on 12th November 2010 in furrows opened at 23 cm apart and seeds were placed at a depth of 3-4 cm, using seed rates as per treatment. The dual purpose barley crop was harvested first for green fodder at 40 days after sowing. After harvesting green fodder, the crop was raised for grain purpose. In RDF, the entire quantity of phosphorus and 1/2 of the nitrogen (30 kg/ha) were drilled in the crop rows about 5 cm below seeding zone at the time of sowing and remaining 1/2 dose of nitrogen (30 kg/ha) was top dressed at the time of Ist irrigation. While in 125 % RDF and 150 % RDF, entire quantity of phosphorus and 30 kg N/ha were drilled at the time of sowing. 30 kg N/ha was top dressed at the time of I irrigation and remaining quantity of nitrogen was top dressed at the time of II nd irrigation after green fodder cutting. For higher green fodder as well as subsequent grain yield the crop was irrigated four times. For boosting growth and application of second dose and additional nitrogen in 125 and 150% RDF, first two irrigations were given at 21 days interval. The last two irrigations were given at 72 and 95 DAS. In order to control weeds, 2,4-D at 0.4 kg/ha was sprayed as post emergence at 30 days after sowing. Net returns and BC ratios were calculated on basis of prevailing market prices of input and produce. LAI, total digestible nutrients, crude fibre, protein content, nitrogen and phosphorus content were estimated by using standard methods for analysis and formula.

RESULTS AND DISCUSSION

Performance of Varieties

Dual purpose barley variety RD 2552 attained significantly higher plant height, dry matter accumulation and LAI consequently higher green fodder yield compared to RD 2035. Green fodder of both the varieties content almost equal total digestible nutrient and crude fibre, however, protein content, N and P accumulation of variety RD 2552 were significantly higher over RD 2035. Under identical agronomical conditions, the marked variation in growth of both varieties could be ascribed to their genetic capabilities to exploit available resources for their growth and development (Thakur *et al.,* 2004). The significant improvement in protein content of green fodder of variety RD 2552 over RD 2035 might be on account of increased N uptake of variety RD 2552 (Verma and Sarkar, 2010).

After harvesting of green fodder the crop was raised for grain purpose and it was observed that barley variety RD 2552 attained significantly higher plant height, dry matter, LAI total effective tiller compared to RD 2035. The barley variety RD 2552 had significantly higher seeds/ear and higher test weight consequently exhibited significant superiority in terms of grain, straw and grain equivalent yields and proved economically beneficial compared to RD 2035 with significantly higher net returns Rs. 4958/ha and BC ratio 0.30. Grain and straw of the variety RD 2552 accumulated significantly higher N and P compared to RD 2035. The significant increase in yield attributes in var. RD 2552 seems to be on account of overall improvement in growth after harvest of green fodder as evinced from higher production of dry matter, plant height, LAI as well as N and P uptake at harvest which subscribes to be the view that there was greater availability of growth inputs required for formation of higher effective tillers and development of other yield components consequently yields (Thakur *et al.,* 2004).

Seed Rate

Highest plant height and green fodder yield were recorded under 150 kg seed/ha which were at par with 125 kg seed/ha, however proved significantly higher over 100 kg seed/ha. Seed rates failed to influence N, P uptake, protein content, total digestible nutrients, crude fibre content and LAI of green fodder significantly. The improvement in plant height with increased seed rate seems to be the resultant of mutual seeding due to overcrowding of plants. Hozumi *et al.* (1955) established this as "cooperative interaction" where in smaller plants tends to catch up with the taller ones by mean of it and compete more on even terms.

After green fodder cutting and at harvest of grain crop, seed rate failed to record significant variation in plant height, dry matter accumulation, grains/ear and test weight, N and P accumulation by grain and straw, however, 125 kg seed/ha significantly increased LAI, number of total and effective tillers, grain, straw, grain equivalent yields, net returns and BC ratio over 100 kg seed/ha. Improvement in number of tillers 0.5/m row length and LAI might be on account of increased number of seeds 0.5/m row length (Yadav *et al*., 2003).

TABLE 1
Performance of dual purpose barley varieties under varying seed rate and fertility levels growth, quality of green fodder and nutrient uptake by green fodder, grain and stover

Treatment	At fodder cutting			Green fodder				Nutrient uptake (kg/ha)					
	Dry matter (g/0.5RL*)	Plant height (cm)	LAI	Protein content (%)	TDN (%)	Crude fiber (%)	Yield (t/ha)	Green fodder		N		P	
								N	P	Grain	Stover	Grain	Stover
Varieties													
RD 2552	45.93	51.0	2.18	15.06	63.70	22.82	21.21	49.19	8.62	38.57	7.48	8.19	1.69
RD 2035	40.99	48.2	1.99	14.97	63.66	23.08	19.39	39.96	6.36	31.90	6.40	6.96	1.25
S. Em±	0.654	0.739	0.025	0.015	0.020	0.152	0.315	0.791	0.157	0.879	0.189	0.201	0.041
C. D. (P=0.05)	1.87	2.12	0.07	0.050	NS	NS	0.906	2.274	0.451	2.525	0.544	0.579	0.118
Seed rate (kg/ha)													
100	42.22	47.56	2.08	15.06	63.66	23.00	19.15	44.49	7.49	33.56	6.53	7.09	1.39
125	43.54	49.68	2.08	15.01	63.68	22.94	20.70	44.79	7.52	35.82	7.08	7.72	1.48
150	44.62	51.53	2.10	14.99	63.70	22.91	21.04	44.44	7.46	36.32	7.22	7.91	1.53
S. Em ±	0.80	0.90	0.03	0.025	0.025	0.186	0.386	0.969	0.192	1.076	0.232	0.247	0.050
C. D. (P=0.05)	NS	2.60	NS	NS	NS	NS	1.110	NS	NS	NS	NS	NS	NS
Fertility levels													
RDF	40.50	46.56	1.93	14.50	63.59	23.67	19.24	38.86	6.67	29.39	5.89	6.31	1.08
125% RDF	44.39	50.72	2.11	15.18	63.71	22.68	20.70	45.56	7.60	37.40	7.39	8.04	1.64
150 % RDF	45.49	51.49	2.22	15.37	63.74	22.50	20.95	49.31	8.19	38.92	7.55	8.38	1.68
S. Em ±	0.80	0.90	0.03	0.025	0.025	0.186	0.386	0.969	0.192	1.076	0.232	0.247	0.050
C. D. (P=0.05)	2.30	2.60	0.08	0.076	0.070	0.535	1.110	2.785	0.552	3.093	0.666	0.709	0.145

*RL: Row length

TABLE 2
Performance of dual purpose barley varieties under varying seed rate and fertility levels growth, yield and economics after green fodder cutting

Treatment	Plant height at (cm)	DM at harvest RL)	LAI at 80 DAS	No of tillers/0.5m row length at harvest		No of grain/ ear	Test weight (g)	Yield (t/ha)			Net returns (Rs./ha)	B : C ratio
				Total tiller	Effective tiller			Grain	Stover	Grain equivalent		
Varieties												
RD 2552	68.30	58.20	1.96	56.00	45.3	20.90	31.10	2.39	2.77	4.51	31140	1.70
RD 2035	64.00	52.90	1.78	54.80	42.5	19.20	28.90	2.12	2.44	4.06	26182	1.40
SEm ±	0.814	0.617	0.02	0.676	1.264	0.361	0.533	0.047	0.052	0.077	849	0.047
C.D (P=0.05)	2.336	1.774	0.02	NS	3.634	1.037	1.531	0.136	0.151	0.223	2440	0.134
Seed rate (kg/ha)												
100	64.83	56.28	1.76	53.20	39.5	19.90	29.80	2.13	2.46	4.04	26291	1.47
125	66.71	55.21	1.91	55.50	45.5	20.10	30.30	2.29	2.66	4.36	29540	1.63
150	66.93	55.17	1.94	57.50	46.7	20.10	30.00	2.34	2.69	4.45	30153	1.64
SEm ±	0.995	0.756	0.026	0.828	1.549	0.442	0.653	0.058	0.054	0.094	1039	0.057
C.D (P=0.05)	NS	NS	0.076	2.381	4.451	NS	NS	0.167	0.185	0.272	2988	NS
Fertility levels												
RDF	61.63	52.11	1.71	52.50	40.3	17.70	27.50	1.98	2.28	3.91	24649	1.38
125% RDF	67.78	56.36	1.93	56.50	44.8	20.80	30.80	2.36	2.76	4.43	30371	1.67
150 % RDF	69.06	58.20	1.97	57.20	46.5	21.60	31.70	2.42	2.78	4.52	30963	1.68
SEm ±	0.995	0.756	0.026	0.828	1.549	0.442	0.653	0.058	0.064	0.094	1039	0.057
C.D (P=0.05)	2.861	2.176	0.076	2.381	4.451	1.270	1.876	0.167	0.185	0.272	2988	0.164

*RL: Row length

Fertility Management

Application of 125% RDF significantly improved plant height, LAI, green fodder yield, protein content and total digestible nutrient content of green fodder, however, crude fibre content decreased with increase in fertility levels.. Highest N and P uptake of green fodder were recorded under 150 % RDF which were significantly higher over 125 % RDF and RDF.

At harvest of grain crop, growth parameters, yield attributes, grain, straw, grain equivalent yields, N and P uptake by grain and stover recorded under 125 % RDF were significantly higher over RDF. Further increase in fertility level failed to record statistical superiority over RDF. Application of 125 % RDF also proved economically beneficial compared to 150 % RDF and RDF. Under present investigation application of 125 and 150 % RDF on various growth parameters of the crop before and after harvesting green fodder appears to be on account of enrichment of soil with both of these nutrients to the level of sufficiency. The larger canopy development and plant height under the application of 25 to 50 per cent additional fertilization could be reasoned for increased interception, absorption and utilization of radiant energy which in turn increased overall growth, photosynthesis, LAI, total tillers, plant height and finally dry matter and yields (John *et al.*, 2008). The improvement in protein under the influence of additional N and P fertilization seems to be on account of increased N content of grain decrease in crude fiber content might be due to synthesis of more structural carbohydrates at later stages (Yadav *et al.,* 2003).

It is concluded that under prevailing agro climatic condition dual purpose barley variety RD 2552 with 125 kg seed rate/ha, fertilized with 75 kg N + 25 kg P_2O_5 ha-1(Full P + 30 kg at sowing and 30 kg N at Ist irrigation + remaining N after cutting i.e. at 40 days after sowing) proved most efficient and economically viable practice for dual purpose barley. Though this interaction effect was not significant, however, fetched highest net returns of Rs. 34453/ha and benefit cost ratio of 1.85.

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