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RESEARCH PAPER

Fodder productivity and economics of berseem cultivation as influenced by varieties, row spacing and nutrient levels in transitional tract of peninsular India

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Abstract: A field experiment was conducted during *rabi* seasons of 2020-21 and 2021-22 under irrigated conditions on red sandy loamy soil to study the fodder productivity and economics of berseem as influenced by varieties, row spacing and nutrient levels. The treatments comprised of three varieties *viz*., 'Vardhan', 'BB 2' and 'BB 3'; two row spacings *viz*., 30 and 45 cm; and three nutrient levels *viz*., 75%, 100% and 125% of RDF. The results indicated that variety 'BB 2' recorded significantly higher green fodder (19.20 t ha^{-1}), dry fodder (2.67 t ha^{-1}) yield and net returns (₹ 34763 ha^{-1}) as compared to 'BB3' and 'Vardhan'. The sowing of beerseen in 45cm row spacing being on par with 30cm row spacing recorded higher green fodder (17.41 t ha^{-1}), dry fodder (2.43 t ha^{-1}) yield and net returns (₹ 29395 ha^{-1}). Among the nutrient levels, application of 125% of RDF recorded significantly higher green fodder (18.96 t ha^{-1}), dry fodder (2.66 t ha^{-1}) yield and net returns (₹ 32345 ha^{-1}). The combination of berseem variety 'BB 2' with 125% of RDF at 45 cm row spacing recorded higher green fodder (22.18 t ha^{-1}), dry fodder (3.07 t ha^{-1}) yield and net returns (₹ 42005 ha^{-1}) as compared to other treatment combinations.

Key words: Berseem, Economics, Nutrient levels, Row spacing, Varieties

Introduction

In Karnataka, the area under winter fodder crops is less and only few fodder crops like fodder sorghum, lucerne, fodder cowpea *etc*. are grown. The perennial fodder grasses remain dormant during winter season and their productivity is low leading to wider gap between fodder demand and availability. This adversely affects the livestock productivity and profitability during winter season. Hence, cultivation of fodder crops having superior quality and higher productivity is need of the hour for continuous availability of green fodder during the winter season (Somashekar *et al*., 2014).

In this regard, there is a need for cultivation of typical cool season fodder crops such as oats, barley, berseem, rye grass *etc*. which are potential fodder crops grown in Northern parts of India where the temperatures are quite low and the cool conditions exist for longer period of time. Among different leguminous fodder crops, berseem is the predominant fodder crop of winter in the entire North West Zone, Hill Zone and part of Central and Eastern Zone of the country occupying an area of 2 million hectares. Berseem is well known for its digestibility and palatability especially to the milch animals. It has 20-24% crude protein and 70% dry matter digestibility. It is rich in crude fibre, ash content, nitrogen free extract, calcium and phosphorus (Chatterjee and Das, 1989). It provides fodder with high biomass over a long period from late winters to early summers *i.e*., November to May with 5 – 6 cuts. In addition, being a leguminous crop, it has an excellent nitrogen fixing capacity to the tune of 100–200 kg of nitrogen/ ha/ year (Daneshnia *et al*., 2015). These all characteristics make it popular in meeting fodder demand during winter season. However, its potentiality has not been evaluated in peninsular India.

Generally, the fodder crops are cultivated without recommended amount nutrients in a balanced manner. Very less amount of work is reported on the response of fodder crops to nutrients and the farmers do not have a tendency to invest on fertilizers for fodder crops (Malakar *et al*. 2009). Further there are no studies on nutrient requirement of different berseem varieties under different crop geometry. Keeping all these points in view, the present experiment was carried out to evaluate the performance of different berseem varieties under different row spacing and nutrient levels to obtain higher productivity and profitability.

Material and methods

A field experiment was conducted during winter seasons of 2020-21 and 2021-22 at Fodder Production Scheme, Main Agricultural Research Station, University of Agricultural Sciences, Dharwad under irrigated conditions on red sandy loam soil. Soil of the experimental site was slightly alkaline in reaction (pH 7.73), low in organic carbon (0.48%) and available N (217.9 kg ha^{-1}), and high in available P (24.8 kg ha^{-1}) and K (298.6 kg ha^{-1}).The experiment consisted of 18 treatment combinations of 3 varieties *viz*., 'Vardhan', 'BB 2' and 'BB 3' in main plots, 2 row spacings *viz*., 30 and 45 cm in sub plots and 3 nutrient levels *viz*., 75%, 100% and 125% RDF levels in sub-sub plots laid out in split-split plot design replicated thrice. The experimental plot was ploughed and harrowed to bring the soil to fine tilth. A uniform dose of 12.5 t ha^{-1} of well decomposed farm yard manure was applied and mixed in the soil prior to sowing. Berseem varieties were sown with a seed rate of 25 kg ha^{-1} in the first fortnight of November 2020 and harvested on first fortnight of March 2021 during first year and in second year it was sown on second fortnight of October 2021 and harvested on second fortnight of February 2022. Mean maximum temperatures varied from 28.9 to 31.7 °C during 2020-21 and 28.1 to 34.8 °C during 2021-22. The Mean minimum temperature ranged from 14.6 to 21.4°C during 2020-21 and 14.0 to 21.3°C during 2021-22. Only two cuts were possible during 2020-21 while three cuts were possible during 2021-22 owing to variable weather conditions. The experimental field was irrigated at weekly interval to maintain optimum soil moisture conditions. The recommended dose of fertilizer (RDF) @ 25:80: 30 kg N: P_2O_5: K_2O ha^{-1} was applied as per the treatments in the form of urea, single super phosphate (SSP) and muriate of potash (MOP). The green fodder yield was recorded plot wise immediately after harvest. Dry fodder yield was computed by multiplying the correction factor of difference in the moisture before drying and after drying multiplied with green fodder yield. The cost of cultivation was computed taking into consideration the cost of various operations and inputs used for raising the crop. The gross returns was computed using the prevailing market price for the produce. The net returnswere computed by deducting the cost of cultivation from the gross returns. The benefit:cost ratio was worked out by dividing the gross returns by cost of cultivation. The experimental data recorded were analyzed statistically as per Analysis of Variance (ANOVA) technique suggested by Gomez and Gomez (1984).

Results and discussion

Green and dry fodder yield

Effect of varieties

The results of two years indicated that berseem variety 'BB 2' recorded significantly higher green (19.20 t ha^{-1}) and dry fodder yield (2.67 t ha^{-1}) as compared to 'BB3' (18.62 and 2.63 t ha^{-1}, respectively) and 'Vardhan' (13.83 and 1.91 t ha^{-1}, respectively) (Table 1). The difference in yields among the varieties might be due to genetic potential and morphological characteristic in exploiting the climatic optima at important crop growth stages. These results are in agreement with the findings of Kaur *et al*. (2013) who reported that in 'PL 172' variety of fodder barley recorded significantly higher yield of dry fodder as compared 'PL 426' and 'RD 2552' due to higher yield potential.

Effect row spacing

Sowing of berseem at 45 cm recorded higher green and dry fodder yield (17.41 and 2.43 t ha^{-1}, respectively). However, it was on par with 30 cm row spacing (17.02 and 2.38 t ha^{-1}, respectively). The higher yield with 45 cm row spacing was mainly due to ample availability of space, moisture, solar radiation, efficient utilization of resources and nutrients as compared to closer row spacing of 30 cm. The higher green and dry fodder yield in 45 cm row spacing are resultant of higher growth parameters obtained throughout the crop period.

Table 1. Fodder yield of berseem as influenced varieties, row spacings and nutrient levels (Mean of 2 years)

Treatments		Green fodder yield (t ha^{-1})				Dry fodder yield (t ha^{-1})			
		V_1	V_2	V_3	S X N	V_1	V_2	V_3	S X N
			V X S X N				V X S X N		
S_1	N_1	13.77	17.18	16.52	15.82	1.91	2.40	2.33	2.22
	N_2	14.33	17.84	17.49	16.55	1.96	2.47	2.48	2.30
	N_3	15.17	20.90	20.03	18.70	2.11	2.91	2.88	2.63
S_2	N_1	12.07	17.45	16.22	15.25	1.65	2.44	2.28	2.12
	N_2	13.76	19.67	19.87	17.77	1.91	2.73	2.79	2.48
	N_3	13.91	22.18	21.60	19.23	1.94	3.07	3.03	2.68
			V X S		S (Mean)		V X S		S (Mean)
S_1	14.42	18.64	18.01	17.02	1.99	2.59	2.57	2.38	
S_2	13.25	19.77	19.23	17.41	1.83	2.75	2.70	2.43	
			V X N		N (Mean)		V X N		N (Mean)
N_1	12.92	17.31	16.37	15.53	1.78	2.42	2.31	2.17	
N_2	14.04	18.76	18.68	17.16	1.93	2.60	2.64	2.39	
N_3	14.54	21.54	20.81	18.96	2.03	2.99	2.96	2.66	
N (Mean)	13.83	19.20	18.62	-	1.91	2.67	2.63	-	
Source of variation		S. Em.±		C. D. (P=0.05)		S. Em.±		C. D. (P=0.05)	
V		0.12		0.49		0.02		0.07	
S		0.13		0.45		0.02		0.06	
N		0.29		0.86		0.04		0.12	
V X S		0.22		0.78		0.03		0.11	
V X N		0.51		1.21		0.06		0.17	
S X N		0.42		1.44		0.07		0.20	
V X S X N		0.72		2.10		0.10		0.29	

Note: RDF : 25: 80:30 kg N, P_2O_5 and K_2O
Main plot : Varieties (V) Sub plot : Row spacings (S) Sub sub plot : Nutrient levels (N)
V_1: Vardhan S_1: 30 cm N_1: 75% RDF
V_2: BB 2 S_2: 45 cm N_2: 100% RDF
V_3: BB 3 N_3: 125% RDF

Manjunatha *et al*. (2014) also reported higher green fodder and dry matter yield with 45 cm and 60 cm row spacing as compared to 30 cm row spacing.

Effect of nutrient levels

Among the nutrient levels, application of 125% RDF recorded significantly higher green and dry fodder yield (18.96 and 2.66 t ha^{-1}, respectively) as compared to 100% (17.16 and 2.39 t ha^{-1}, respectively) and 75% RDF (15.53 and 2.17 t ha^{-1}, respectively) (Table 1). The higher fertility levels accelerated the process of cell division, enlargement and stem elongation leading to luxuriant growth and higher yield. The bioavailability and concentration of fodder minerals varies greatly depending on fertilizer application. Nutrient application management and appropriate cultivar appears to be important parameters for obtaining high fodder quality yields and high nutritive value of berseem clover in semi-arid regions. These findings are in conformity with the findings of Karwasra *et al.* (1998) who observed that application of 100 per cent recommended dose of nitrogen (60 kg ha^{-1}) recorded significantly higher green fodder yield and dry matter yield of barley as compared to other levels of nitrogen.

Interaction effect

Interactions among the berseem varieties, row spacings and nutrients levels indicated that the berseem variety 'BB 2' sown at 45 cm rows with nutrient level of 125% RDF recorded significantly higher green (22.18 t ha^{-1}) and dry fodder yields (3.07 t ha^{-1}) as compared to rest of the treatment combinations except variety 'BB 3' sown at 45 cm rows with nutrient level of 125% RDF with which it was on par (Table 1).This can be attributed to the genetic potential of varieties to utilize wider spacing under sufficient nutrient availability conditions and translocation of photosynthates from source and sink. This could also be substantiated with the reason that the higher productivity per unit area can be obtained by efficient utilization of natural growth resources like light, CO_2, water, nutrients and space. The yield potential of a particular variety can be exploited under optimal row spacing in a given environment where competition is minimum under higher fertility levels with sufficient supply of nutrients. Manjunatha *et al.* (2014) also reported that combination of 45 cm row spacing along with 300 kg N ha^{-1} recorded higher total green fodder and total dry matter yield in fodder sorghum.

Gross returns, net returns and B:C ratio

Economics is an important criterion to decide or assess the best agrotechnique. The highest gross returns (₹ 57612 ha^{-1}), net returns (₹ 34763 ha^{-1}) and B:C ratio (2.51) were recorded with berseem variety 'BB 2' as compared to other varieties (Table 2). This is attributed mainly to higher green fodder yield recorded in this variety.

Table 2. Economics of berseem as influenced varieties, row spacings and nutrient levels (Mean of 2 years)

Treatments		Cost of Cultivation (₹ ha^{-1})				Gross returns (₹ ha^{-1})				Net returns (₹ ha^{-1})				Benefit:cost ratio			
		V_1	V_2	V_3	S X N	V_1	V_2	V_3	S X N	V_1	V_2	V_3	S X F	V_1	V_2	V_3	SX N
			V X S X N				V X S X N				V X S X N				V X S X N		
S_1	N_1	21234	21234	21234	21234	41295	51536	49567	47466	20061	30301	28332	26231	1.94	2.42	2.33	2.23
	N_2	22766	22766	22766	22766	42983	53524	52463	49656	20217	30758	29697	26890	1.88	2.35	2.30	2.18
	N_3	24547	24547	24547	24547	45497	62697	60076	56090	20950	38150	35528	31543	1.85	2.55	2.44	2.28
S_2	N_1	21234	21234	21234	21234	36195	52346	48668	45736	14961	31112	27433	24502	1.70	2.46	2.29	2.15
	N_2	22766	22766	22766	22766	41281	59018	59605	53301	18515	36252	36839	30535	1.81	2.59	2.61	2.34
	N_3	24547	24547	24547	24547	41741	66552	64790	57694	17194	42005	40242	33147	1.70	2.71	2.63	2.35
			V X S		S(Mean)		V X S		S(Mean)		V X S		S(Mean)		V X S		S(Mean)
S_1	22849	22849	22849	22849	43258	55919	54035	51071	20409	33070	31186	28222	1.89	2.44	2.36	2.23	
S_2	22849	22849	22849	22849	39739	59305	57688	52244	16890	36456	34838	29395	1.74	2.58	2.51	2.28	
			V X N		N(Mean)		V X N		N(Mean)		N(Mean)		V X N		N(Mean)		V X N
N_1		21234	21234	21234	21234	38745	51941	49117	46601	17511	30707	27883	25367	1.82	2.44	2.31	2.19
N_2		22766	22766	22766	22766	42132	56271	56034	51479	19366	33505	33268	28713	1.85	2.47	2.46	2.26
N_3		24547	24547	24547	24547	43619	64625	62433	56892	19072	40077	37885	32345	1.77	2.63	2.54	2.31
N (Mean)		22849	22849	22849		41499	57612	55861	-	18649	34763	33012		1.81	2.51	2.43	-
Source of variation		S.Em.±		C.D.(P=0.05)		S.Em.±		C.D. (P=0.05)		S.Em.±		C.D(P=0.05)		S. Em.±		C.D.(P=0.05)	
V		166		651		374		1467		213		834		0.016		0.062	
S		168		581		388		1344		222		768		0.018		0.061	
N		375		1096		881		2572		512		1495		0.038		0.112	
V X S		291		1006		673		2328		384		1330		0.031		0.106	
V X N		650		1550		1246		3638		887		2115		0.067		0.159	
S X N		531		1845		1526		4330		725		2517		0.054		0.189	
V X S X N		920		2685		2159		6300		1255		3663		0.094		0.275	

Note: RDF : 25: 80:30 kg N, P_2O_5 and K_2O

Main plot : Varieties (V) Sub plot : Row spacings (S) Sub sub plot : Nutrient levels (N)

V_1: Vardhan S_1: 30 cm N_1: 75% RDF

V_2: BB 2 S_2: 45 cm N_2: 100% RDF

V_3: BB 3 N_3: 125% RDF

Between the row spacings, 45 cm rows recorded significantly higher gross returns, net returns and benefit cost ratio (₹ 52244 ha^{-1}, 29395 ha^{-1} and 2.28, respectively) as compared to 30 cm row spacing (Table 2). This was mainly due to significantly higher green fodder yields recorded with 45 cm row spacing as compared to 30 cm. These results are in line with observations of Velayudham *et al.* (2011) in sorghum crop.

The nutrient application of 125 % RDF recorded significantly higher gross returns (₹ 56892 ha^{-1}), net returns (₹ 32345 ha^{-1}) and B: C ratio (2.31) as compared to other levels of nutrients. This is mainly attributed to increased availability of nutrients for longer period of time with the highest level of nutrient's application which culminated in better growth and yield leading to higher monetary benefits. The lowest net returns (₹ 25367 ha^{-1}) were realized with 75% RDF which was mainly due to lower green fodder yield. Similar results were also reported by Kumar and Chaplot (2015) in multi cut sorghum where higher fertility of 100% RDF recorded highest net returns and B:C ratio as compared to lower fertility levels.

The interactions among berseem varieties, row spacings and nutrients levels indicated that the combination of berseem variety 'BB 2' sown at 45 cm rows with nutrient level of 125% RDF recorded higher gross returns (₹ 66552 ha^{-1}), net returns (₹ 42005 ha^{-1}) and B:C ratio (2.71). However, it was on par with berseem variety 'BB 3' sown at 45 cm rows with nutrient level of 125% RDF. This could be due to higher green fodder yield obtained with those varieties and their ability to exploit wider row spacing and higher nutrient availability leading higher monetary returns and B:C ratio. These results are in agreement with those of Velayudham *et al.* (2011).

Conclusion

Based on findings of this experiment, it is concluded that growing of berseem variety 'BB2' in 45 cm row spacing with the nutrient level of 125% RDF results in higher green and dry fodder yields, net returns and return per rupee invested in transitional tract of peninsular India.

References

Chatterjee B N and Das P K, 1989, Forage Crop Production, Principles and Practices. Oxford and IBH Publishing Co. Pvt. Ltd.

Daneshnia F, Amini A and Chaichi M R, 2015, Surfactant effect on forage yield and water use efficiency for berseem clover and basil in intercropping and limited irrigation treatments. *Agricultural Water Management*, 160: 57-63.

Gomez K A and Gomez A A, 1984, Statistical procedures for agricultural research: John Wiley & Sons. New York.

Karwasra R S, Gupta S N and Kadian R S, 1998, Response of barley varieties to nitrogen under rainfed conditions of Rohtak. *Crop Research*, 15: 31-33.

Kaur G, Singh A, Aulakh C S and Gill J S, 2013, Variation in fodder yield and quality trait of dual purpose barley under different agronomic practices. *Forage Research*, 39(1):42-44.

Kumar D and Chaplot P C, 2015, Effect of fertility levels on quality of multi-cut forage sorghum varieties. *Forage Research*, 40(4): 251-253.

Malakar B, Mondal S, Bandopadhyay P and Kundu C K, 2009, Response of fodder oat (*var*. OS-6) to nitrogen and phosphate fertilizers in the new alluvial zone of West Bengal. *Journal of Crop and Weed*, 5(2):36-38.

Manjunatha S B, Angadi V V, Palled Y B and Hosamani S V, 2014, Nutritional quality of multicult fodder sorghum (CoFS-29) as influenced by different row spacings and nitrogen levels under irrigated condition. *Environment and Life Science*, 7(3): 179- 182.

Somashekar K, Shekara B G, Kalyanamurthy K and Lalitha B, 2014, Green fodder augmentation for increasing animal productivity–a review. *Forage Research*, 40(3): 147-153.

Velayudham K, Babu C, Iyanar K and Kalamani A, 2011, Impact of plant geometry and fertilizer levels on bajra napier hybrid grass. *Indian Journal of Agricultural Sciences*, 81(6): 575-582.