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Assessment of forage berseem (*Trifolium alexandrinum* L.) for productivity and profitability under varying seed rates and phosphorus fertilization

***M. ARIF, A. KUMAR, R. POUROUCHOTTAMANE, D.L. GUPTA AND B. RAI**

ICAR- Central Institute for Research on Goats, Makhdoom, Mathura, India

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ABSTRACT

An experiment on forage berseem was conducted in the winter season of 2020-21 at ICAR-CIRG, Makhdoom, Mathura (UP) to study the productivity and profitability of forage berseem under varying seed rates and phosphorus fertilization. The treatments consist of seeding rates viz. 20, 25 and 30 kg ha^{-1} and five levels of phosphorus from 40 to 120 kg ha^{-1}. The experiment was replicated thrice in factorial RBD. The result showed that maximum total green (78.95 t ha^{-1}) and dry (8.65 t ha^{-1}) forage yield, total nutrient uptake and maximum BC ratio ratio of forage berseem was found with 30 kg of seed rate ha^{-1}. However, 25 and 30 kg of seed rate recorded at par value of yield, nutrient uptake and economics. Further, among different phosphorus levels, 120 kg P_2O_5 ha^{-1} registered highest total forage yield (83.74 t ha^{-1}); total nutrient uptake and BC ratio of forage berseem. However, 100 and 120 kg P_2O_5 ha^{-1} was found at par in terms of yield, nutrient content and uptake and economics in forage berseem.

Keywords: *Berseem, fodder production efficiency, net returns, nutrient content and uptake, phosphorus levels.*

Green fodder if an important source of nutrient which governs growth and development in livestock, but shortage of this important source is a common problem in India. This problem further aggravated as fodder crops grow in less than 5% of the cropped area in our country. Therefore, to overcome this problem, cultivation of forage crop which provides good quality green fodder for relatively longer period is need of the hour. Berseem occupies an important place among the different *rabi* season fodder crops in northern part of India (Kumawat and Khinchi, 2017). It is popular due to its capacity to provide better quality green fodder for relatively longer period with very high quantum (Singh *et al*., 2019). Seed rate had significant effect on plant population, plant growth, productivity and profitability in forage crops. For efficient utilization of resources, optimum levels of plant population is utmost required which is governed by seed rate (Ayub *et al*., 2002). Further, phosphorus is essential element for biosynthesis of chlorophyll, development of root nodules in leguminous crops and needed for cell division and development of meristematic tissues. Thus deficiency of this nutrient causes reduction in photosynthesis and leaf expansion which ultimately leads to reduction in fodder yield (Kumar *et al*., 2016). Phosphorus also helps in photosynthesis, synthesis of lipids, proteins, nucleic acids and other important compounds (Guinn, 1984). Berseem required appropriate quantity of phosphorus for the formation of root nodules which resulted into nitrogen fixation in plant roots (Kumawat and Khinchi, 2017).

Mobeena *et al*. (2022) reported that at higher phosphorus application microbial activity increased which improve nutrient translocation and contributed to higher nutrient contents in the plant tissue; and contributed in production of higher dry fodder yield. Agronomic practices of berseem with respect to seed rate and application of phosphorus fertilization has not been evaluated extensively in Yamuna ravines region of Uttar Pradesh. Also the optimization of seed rate and phosphorus fertilizer is important due to increasing cost of these agricultural inputs worldwide. Hence, the study was conducted to optimize the seed rate and phosphorus fertilizer in berseem for getting maximum productivity and profitability.

MATERIALS AND METHODS

A study on forage berseem was conducted in the winter season of 2020-21 at ICAR-CIRG, Makhdoom, Mathura (UP) to know the effect of seed rates and phosphorus application in berseem. Soil status of experimental site was recorded before the experimentation and was found 238, 40 and 167 kg ha^{-1} of N, P and K, respectively. The treatments of experiment included 20, 25 and 30 kg ha^{-1} of seed rate and 40, 60, 80, 100 and 120 kg ha^{-1} of P_2O_5. The study was planned in RBD (factorial) with three replications.

Berseem variety Wardan was sown on 6th November, 2020 by broadcasting method using the seed rate as per the treatments. As per treatment, total amount of phosphorus and N (20 kg ha^{-1}) was broadcasted before the sowing. The crop was harvested in four cuttings at 45, 85, 115 and 145 days after sowing. Green forage yield was obtained after harvesting of forage berseem from net plots. Dry forage yield was obtained after

Email: arifkhan.ag782@gmail.com

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drying of green fodder at 65 ^{0}C. Production efficiencies of green and dry fodder yield were calculated by dividing the green or dry fodder yield from cutting period. Estimation of nutrients in forage berseem was done as per the following methods (Table 1). For estimation of nutrient uptake (N, P and K) dry fodder yield was multiplied by respective nutrient content and expressed as nutrient uptake in kg ha^{-1}.

$$\text{Nutrient uptake } \left(\text{kg ha}^{-1}\right) = \frac{\text{Nutrient content \% x dry fodder yield } (\text{kg ha}^{-1})}{100}$$

Table 1: Methods for estimation of nitrogen, phosphorus and potassium

Nutrient	Method
N	Micro Kjeldahl method
P	Vanadomolybdate phosphoric method (Richards, 1968)
K	Flame Photometeric method (Richards,1968)

Profitability of different treatments was calculated by net returns and BC ratio. Data analysis was done by using the method given by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Fodder yield and production efficiency

Data revealed that maximum total green (78.95 t ha^{-1}) and dry (8.65 t ha^{-1}) forage yield, green (545 kg ha^{-1} day^{-1}) and dry (60 kg ha^{-1} day^{-1}) forage production efficiencies were found with seeding rate of 30 kg ha^{-1}. However, 25 and 30 kg ha^{-1} recorded at par value of yields and production efficiencies of berseem. Seeding @ 30 kg ha^{-1} registered higher green fodder yield (29.17 %), dry fodder yield (32.87 %), green fodder production efficiency (29.15 %) and dry fodder production efficiency (33.33 %) over 20 kg ha^{-1} (Table 2). The higher yield with increased seed rate might be due to efficient utilization of natural resource which leads to higher growth and development (Pasumarty *et al.,* 1996). Although, after the optimal seed rate a competition between plants occurs which leads to decreased yield (Read *et al*., 2013). The maximum values of green fodder yield with higher seed rate are in close confirmation with Narwal and Sardana (2002) who observed that forage yield of berseem increased with increasing seed rate. Arzani (2000) also recorded that highest yield of dry matter at seeding @ 20 kg ha^{-1}.

Further, among the different phosphorus fertilizers, 120 kg P_2O_5 ha^{-1} registered maximum total green (83.74 t ha^{-1}) and dry (9.24 t ha^{-1}) forage yield, and green (578 kg ha^{-1} day^{-1}) and dry (64 kg ha^{-1} day^{-1}) forage production efficiencies. However, 100 and 120 kg P_2O_5 ha^{-1} were found at par in terms of yield and production efficiencies (Table 2). Phosphorus @ 120 kg ha^{-1} registered higher green fodder yield by 58.09, 23.66 and 10.94 % and dry fodder yield by 66.79, 27.62 and 13.79 % over 40, 60 and 80 kg P_2O_5 ha^{-1}, respectively. The observations are in close confirmation with Satpal *et al*. (2020) who found that significantly highest total yield of berseem was reported with 100 kg P_2O_5 ha^{-1} in total of four cuts. Kumawat and Khinchi (2017) found that 80 kg phosphorus ha^{-1} registered maximum green forage yield of berseem.

Nutrient content and uptake

Significantly highest value of total N (240.2 kg ha^{-1}), total P (26.1 kg ha^{-1}) and total K (249.1 kg ha^{-1}) uptake was found with the seeding @ 30 kg ha^{-1}. However, seed rate of 25 and 30 kg ha^{-1} recorded at par values of uptakes of all these nutrients (Table 4). Crude protein of fodder maize was not influenced significantly with different seeding rate, as the crude protein content is derived from N x 6.25 thus, seed rate also had no significant effecton N content (Mahdi *et al*., 2012; Subrahmanya *et al*., 2017). As the nutrient uptake by the plants are primarily function of dry matter production potential and their content, hence higher uptake of NPK with the seeding @ 30 kg ha^{-1} may be due to their higher dry matter production efficiency.

Further nutrient content and uptake of berseem were significantly influenced by different levels of phosphorus fertilizers. Highest nitrogen (3.07, 2.90, 2.74 and 2.73 %), phosphorus (0.361, 0.330, 0.323 and 0.265 %) and potassium (3.34, 3.22, 2.83 and 2.80 %) content in berseem was found with 120 kg P_2O_5 ha^{-1} in 1st, 2nd, 3rd and 4th cut, respectively (Table 3). Similarly, significantly highest value of total N (266.6 kg ha^{-1}), P (30.2 kg ha^{-1}) and K (285.3 kg ha^{-1}) uptake was found with 120 kg P_2O_5 (Table 4). Increasing the doses of phosphorus fertilizer increased its uptake (Awan and Abbasi, 2000). In forage sorghum, phosphorus uptake was increased with its increasing application (Hirpara *et al.,* 1992). Kumar *et al.* (2015) found that nitrogen and potassium content was significantly influenced by different levels of phosphorus fertilization in urdbean.

Economics

Seeding @ 30 kg ha^{-1} recorded maximum value of gross return (₹ 78954 ha^{-1}), net return (₹ 35340 ha^{-1})

Table 2: Effect of seed rate and phosphorus fertilization on fodder yield and production efficiencies of forage berseem

Treatments	Green forage yield (t ha^{-1})					Dry forage yield (t ha^{-1})					GFPE (Kg ha^{-1} day^{-1})	DFPE (Kg ha^{-1} day^{-1})
	Cutting				Total	Cutting				Total		
	1st	2nd	3rd	4th		1st	2nd	3rd	4th			
Seeding rate (kg ha^{-1})												
20	20.78	17.39	13.79	9.15	61.12	1.83	1.77	1.70	1.21	6.51	422	45
25	25.34	21.73	17.22	11.98	76.27	2.28	2.24	2.13	1.58	8.24	526	57
30	26.20	22.55	17.84	12.36	78.95	2.41	2.36	2.24	1.64	8.65	545	60
SEm±	**0.57**	**0.55**	**0.53**	**0.51**	**1.08**	**0.06**	**0.07**	**0.07**	**0.07**	**0.17**	**7**	**1**
CD (*p*= 0.05)	**1.64**	**1.59**	**1.52**	**1.48**	**3.13**	**0.18**	**0.20**	**0.20**	**0.19**	**0.48**	**22**	**3**
Phosphorus fertilizer (kg P_2O_5 ha^{-1})												
40	17.89	15.59	11.93	7.56	52.97	1.56	1.56	1.45	0.97	5.54	365	38
60	22.81	19.26	15.12	10.53	67.72	2.03	1.97	1.86	1.38	7.24	467	50
80	25.25	21.48	16.90	11.85	75.48	2.26	2.20	2.09	1.56	8.12	521	56
100	26.91	22.74	18.35	12.66	80.66	2.46	2.38	2.31	1.70	8.86	556	61
120	27.69	23.70	19.13	13.22	83.74	2.55	2.50	2.42	1.78	9.24	578	64
SEm±	**0.73**	**0.71**	**0.68**	**0.66**	**1.40**	**0.08**	**0.09**	**0.09**	**0.09**	**0.22**	**10**	**1**
CD (*p*= 0.05)	**2.11**	**2.05**	**1.96**	**1.91**	**4.04**	**0.24**	**0.26**	**0.25**	**0.25**	**0.62**	**28**	**4**

GFPE: Green forage production efficiency; DFPE: Dry forage production efficiency.

Table 3: Effect of seed rate and phosphorus fertilization on nutrient content in forage berseem

Treatments	Nitrogen (%) Cutting				Phosphorus (%) Cutting				Potassium (%) Cutting			
	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
Seeding rate (kg ha^{-1})												
20	2.86	2.71	2.56	2.54	0.321	0.295	0.277	0.227	3.00	2.84	2.46	2.39
25	2.91	2.75	2.59	2.57	0.328	0.303	0.285	0.232	3.06	2.90	2.56	2.45
30	2.93	2.79	2.61	2.60	0.331	0.306	0.291	0.238	3.10	2.95	2.61	2.51
SEm±	**0.03**	**0.03**	**0.04**	**0.04**	**0.004**	**0.005**	**0.005**	**0.006**	**0.04**	**0.05**	**0.05**	**0.05**
CD (*p*= 0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
Phosphorus fertilizer (kg P_2O_5 ha^{-1})												
40	2.65	2.55	2.39	2.37	0.275	0.258	0.222	0.183	2.63	2.39	2.11	1.87
60	2.81	2.67	2.51	2.48	0.310	0.286	0.265	0.219	2.92	2.75	2.42	2.29
80	2.94	2.77	2.60	2.58	0.335	0.308	0.296	0.240	3.12	2.97	2.61	2.55
100	3.03	2.85	2.68	2.67	0.352	0.324	0.315	0.255	3.25	3.15	2.75	2.73
120	3.07	2.90	2.74	2.73	0.361	0.330	0.323	0.265	3.34	3.22	2.83	2.80
SEm±	**0.04**	**0.04**	**0.05**	**0.05**	**0.005**	**0.006**	**0.007**	**0.008**	**0.05**	**0.06**	**0.07**	**0.07**
CD (*p*= 0.05)	**0.12**	**0.13**	**0.13**	**0.14**	**0.016**	**0.018**	**0.019**	**0.022**	**0.15**	**0.18**	**0.19**	**0.20**

Table 4: Effect of seed rate and phosphorus fertilization on uptake of nutrient in forage berseem

Treatments	Nitrogen uptake (kg ha^{-1})					Phosphorus uptake (kg ha^{-1})					Potassium uptake (kg ha^{-1})				
	Cutting				Total	Cutting				Total	Cutting				Total
	1st	2nd	3rd	4th		1st	2nd	3rd	4th		1st	2nd	3rd	4th	
Seeding rate (kg ha^{-1})															
20	52.9	48.2	43.8	30.6	175.4	6.0	5.3	4.8	2.8	18.8	55.7	50.8	42.8	29.5	178.8
25	67.0	62.4	55.8	41.2	226.3	7.6	6.9	6.2	3.8	24.6	70.7	66.4	55.6	40.0	232.7
30	71.4	66.5	59.1	43.2	240.2	8.1	7.3	6.7	4.0	26.1	76.0	71.2	59.6	42.4	249.1
SEm±	**2.4**	**2.4**	**2.0**	**1.8**	**5.5**	**0.3**	**0.3**	**0.2**	**0.2**	**0.7**	**2.6**	**2.8**	**2.1**	**1.8**	**7.4**
CD (p= 0.05)	**7.0**	**7.1**	**5.8**	**5.2**	**15.9**	**0.8**	**0.8**	**0.6**	**0.5**	**2.0**	**7.6**	**8.2**	**6.0**	**5.2**	**21.5**
Phosphorus fertilizer (kg P_2O_5 ha^{-1})															
40	41.1	39.6	34.5	23.1	138.3	4.3	4.0	3.2	1.8	13.3	40.8	37.0	30.8	18.2	126.8
60	57.3	52.9	47.0	34.4	191.5	6.3	5.6	4.9	3.1	20.0	59.6	54.5	45.1	31.8	191.1
80	66.7	61.2	54.4	40.2	222.5	7.6	6.8	6.2	3.7	24.2	70.9	65.8	54.6	39.8	231.0
100	75.0	68.3	62.1	45.4	250.9	8.7	7.8	7.3	4.3	28.2	80.4	75.6	64.0	46.6	266.7
120	78.6	72.9	66.5	48.6	266.6	9.3	8.3	7.9	4.8	30.2	85.5	81.0	68.8	50.0	285.3
SEm±	**3.1**	**3.2**	**2.6**	**2.3**	**7.1**	**0.3**	**0.3**	**0.3**	**0.2**	**0.9**	**3.4**	**3.6**	**2.7**	**2.3**	**9.6**
CD (p= 0.05)	**9.0**	**9.2**	**7.4**	**6.7**	**20.5**	**1.0**	**1.0**	**0.8**	**0.7**	**2.6**	**9.9**	**10.5**	**7.7**	**6.8**	**27.8**

Table 5: Effect of seed rate and phosphorus fertilization on economics of berseem

Treatments	Gross Return (¹ ha^{-1})	Net Return (¹ ha^{-1})	B:C ratio
Seeding rate (kg ha^{-1})			
20	61118	19304	1.46
25	76267	33553	1.78
30	78954	35340	1.80
SEm±	**1081**	**1081**	**0.03**
CD (*p*= 0.05)	**3132**	**3132**	**0.07**
Phosphorus Fertilizer (kg P_2O_5 ha^{-1})			
40	52969	12505	1.31
60	67716	26127	1.63
80	75481	32767	1.76
100	80658	36819	1.84
120	83741	38777	1.86
SEm±	**1396**	**1396**	**0.03**
CD (*p*= 0.05)	**4044**	**4044**	**0.09**

and BC ratio (1.80) of berseem. However seeding @ 25 kg ha^{-1} registered similar value of gross returns (₹ 76267 ha^{-1}), net return (₹ 33553 ha^{-1}) and BC ratio (1.78) with the seeding @ 30 kg ha^{-1} (Table 5). Higher value of all these profitability parameters with seeding @ 30 kg ha^{-1} might be due to higher green fodder of berseem with this seed rate. Singh (2006) also found significant effect of seed rate on net return and benefit ratio in mustard.

Economics of forage berseem was also influenced by levels of phosphorus fertilizations. The highest gross return (₹ 83741 ha^{-1}), net return (₹ 38777 ha^{-1}) and BC ratio (1.86) of berseem was reported with 120 kg P_2O_5 ha^{-1}. However, 100 and 120 kg P_2O_5 ha^{-1} registered at par value of all these profitability parameters in berseem (Table 5). Similar finding was also reported by Satpal *et al*. (2020) that, highest gross return (₹ 91849 ha^{-1}), net return (₹ 34451 ha^{-1}) and BC ratio (1.60) were registerd with 100 kg P_2O_5 ha^{-1}. Kumawat and Khinchi (2017) also reported that net returns and BC ratio of berseem were also affected due to phosphorus fertilizers.

CONCLUSION

Research finding revealed that seed rate and levels of phosphorus fertilizers significantly influenced the productivity and profitability of forage berseem. Among the seed rate, 30 kg and among P_2O_5 120 kg ha^{-1} registered maximum values of all these parameters. However, seeding @ 25 and 30 kg ha^{-1} and P_2O_5 @ 100 and 120 kg ha^{-1} recorded at par values of all these parameters. Hence, this investigation recommended seeding @ 25 kg and application of P_2O_5 @ 100 kg per hactare for obtaining highest productivity and profitability in forage berseem.

REFERENCES

Arzani, A. 2000. The effects of row spacings and seeding rates on dry matter and seed yield in berseem clover. *J. Sci. Technol. Agric. Nat. Resour.,* **4**: 55-65.

Awan, Z. I. and Abbasi, M. K. 2000. Interactive effect of phosphorus and copper on maize growth. *Pak. J. Agric. Sci.,* **16**(2): 105-108.

Ayub, M., Muhammad, A. N., Tanveer, A. and Husain, A. 2002. Effect of different level of nitrogen and harvesting time on the growth, yield and quality of sorghum fodder. *Asian J. Plant Sci.*, **1**: 304-307.

Gomez, K.A. and Gomez A.A. 1984. Statistical Procedures for Agricultural Research. Int. Rice Res. Inst., John Wiley and Sons. New York, Chichester, Brisbane, Toronto, Singapore.

Guinn, G. 1984. Potential for improving production efficiency with growth regulators. In: Proceedings of the belt wide cotton production research conference. pp: 67-71.

Hirpara, D.S., Patel, J.C., Patel, B.S. and Khanpara, V.D. 1992. Response of rainy season hybrid sorghum to nitrogen and phosphorus. *Indian J. Agron.,* **37**(3): 581-583.

Kumar, P., Pandey, S.K. and Kumar, P. 2015. Effect of different phosphorus levels on nutrient content, uptake and economics of urd bean under custard apple based agri-horti system. *J. AgriSearch,* **2**(2): 88-93.

Kumar, R., Rathore, D.K., Singh, M. Kumar, P. and Khippal, A. 2016. Effect of phosphorus and zinc nutrition on growth and yield of fodder cowpea. *Legume Res.,* **39**(2): 262-267.

Kumawat, S.M. and Khinchi, V. 2017. Effect of phosphorus levels on forage yield of promising multicut genotypes of berseem (*Trifolium alexandrinum* L.). *Forage Res.,* **43**(3): 223-226.

Mahdi, S.S., Hasan, B. and Singh, L. 2012. Influence of seed rate, nitrogen and zinc on fodder maize (*Zea mays*) in temperate conditions of western Himalayas. *Indian J. Agron.,* **57**: 85-88.

Mobeena, Nagamani, C., Prabhakara Reddy G. and Umamahesh, V. 2022. Effect of time of sowing and phosphorus levels on yield and nutrient uptake of fodder cowpea. *Pharm. Innov. J.*, **11**(3): 862-865.

Narwal, S.S. and Sardana, V. 2002. Effect of sowing dates and seed rates on the green forage, seed yield and quality of late sown berseem. *J. Maharashtra Agric. Univ.,* **25** (2): 181-184.

Pasumarty, S.V., Higuchi, S. and Murata, T. 1996. Influence of seed quality on field establishment and forage yield of white clover (*Trifolium repens* L.). *J. Agron. Crop Sci.,* **177**: 321–326.

Satpal, Sheoran, R.S., Tokas, J. and Jindal, Y. 2020. Phosphorus influenced nutritive value, yield and economics of berseem (*Trifolium alexandrinum* L.) genotypes. *Chem. Sci. Rev. Lett.,* **9**(34): 365-373.

Singh, R. 2006. Effect of cropping sequence, seed rate and weed management on weed growth and yield of Indian mustard in Western Rajasthan. *Indian J. Weed Sci.,* **38**: 69-72.

Singh, T., Radhakrishna, A., Seva Nayak D. and Malaviya D.R. 2019. Genetic improvement of berseem (*Trifolium alexandrinum*) in India: Current status and prospects. *Int. J. Curr. Microbiol. Appl. Sci.,* **8**: 3028-3036.

Subrahmanya, D.J., Kumar, R., Tyagi, N., Ram, H., Singh, M., Meena, R.K., Tamta, A. and Pande, A.K. 2017. Yield of fodder maize (*Zea mays*) and its chemical composition under varying plant densities and nutrient management. *Indian J. Anim. Nutri.,* **34**: 425-429.