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Impact of integrated nutrient management (INM) on growth of Berseem (*Trifoliumalexandrinum* L.) at various cutting stages

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Abstract
An experiment was conducted during winter season of 2016-17 on Berseem (cv. Mescavi). The experiment comprised of twelve treatments *viz.* T_1 (control), T_2 (100% RDF, 20 kg N + 80 kg P_2O_5 ha^{-1}), T_3 (100% N through Farm Yard Manure (FYM), T_4 (100% N through Poultry Manure), T_5 (50% RDF +50% N through FYM), T_6 (50% RDF +50% N through Poultry Manure), T_7 (50% N through FYM+50% N through Poultry Manure), T_8 (50% RDF +25%N through FYM +25% N through Poultry Manure), T_9 (75% RDF +25% N through FYM), T_{10} (75% RDF +25% N through Poultry Manure), T_{11} (25% RDF +75% N through FYM) and T_{12} (25% RDF +75% N through Poultry Manure) were tested in Randomized Block Design with three replications. the results revealed that the maximum plant height, fresh weight of leaf and stem, dry weight of leaf and stem, shoot : root ratio $plant^{-1}$ and number of nodules $plant^{-1}$ were observed with the application of 100% RDF (20 kg N + 80 kg P_2O_5 ha^{-1}) fallowed by 75% RDF +25% N through poultry manure and 75% RDF +25% N through FYM.

Keywords: FYM, Poultry manure, INM, growth, RDF, plant height, and leaf

Introduction
Berseem (*Trifoliumalexandrinum* L.) is one of the most important winter forage crop of India, due to high forage yield, palatability and nutritive value. It has become a very popular as *rabi* forage in irrigated areas or all most all over the country. Berseem belongs to one of the largest and most useful plant family leguminaceae and sub family faboideae. Berseem is known as king of fodder crops and it is popular among the world. It is one of the oldest cultivated crops, domesticated in Egypt and later introduced into many other parts of the world. Berseem was introduced in India in 1903 (Roy *et al*., 2009) [5]. It is now widespread in the irrigated regions of west and south Asia. Most of the farmers conserved the berseem as hay to get cheap, palatable and nutritive forage during scarcity periods or early winter and summer. Berseem is a cheapest source of increasing milk production as well as improving soil fertility. Berseem can be sown in early autumn and can thus provide feed before and during the colder months but the optimum conditions are 18-25 °C. If the winter temperature falls to 6-8° C the crop growth is severely affected. This is nutritious, succulent and palatable fodder available for fairly long period during winter, spring and early summer (Chaterjee and Das, 1989) [2]. Grazing is possible though less common than cutting. The most important cultural practices that need to be carefully adjusted to achieve maximum benefit from the forage grass-legume mixtures. The ability to fix atmospheric nitrogen and convert it to a useable form for plant growth is the main trait to these legumes (Allen and Allen, 1981) [1].
Poultry manure is an excellent soil amendment that provides nutrients for growing crops and also improves soil quality when applied widely, because it has high organic matter content combined with available nutrients for plant growth (Ryssen *et al.*, 1993) [7]. The application of FYM with chemical fertilizers and composted with rock phosphate to improve crops yield is very well established (Shafi *et al*., 2012) [8]. Fertilizers play an important role in enhancing forage productivity. Chemical fertilizers are soluble and immediately available to the plants; therefore, the effect is usually direct and fast, the price is lower and they are quite high in

nutrient content; only relatively small amounts are required for crop growth. Organic manures enhance to soil biological activity, which improves nutrient mobilization from organic and chemical sources as well as decomposition of toxic substances, they enhance the colonization of mycorrhizae, which improves P supply, enhance root growth due to better soil structure, increase the organic matter content of the soil, and improving capacity of nutrients. Organic fertilizers seems also to be more appropriate agronomic practices as it considered the important aspects in agronomic clean farming. Among these organic materials are crop residues, farmyard manure.

Materials and methods

The experiment was conducted during the winter season 2016-17 at Agronomy Research Farm, Narendra Deva University of Agriculture & Technology, Kumarganj, Faizabad (U.P), which is located 42 km away from Faizabad. The experimental site falls under humid and sub-tropical climate and located at 26.47^0 N latitude and 82.12^0 E longitudes on an elevation of about 113 meter above mean sea level in the indo-gangetic alluvial soil belt of Eastern Uttar Pradesh. These region receives a mean annual precipitation about 1200 mm. Maximum rainfall in this area is received from mid-June to end of September. However, occasional showers are very common in the month of January and February. The winter months are cold whereas, summer months are extremely hot, the western hot winds locally known as Loo, starts from April and continued till the onset of monsoon in the month of June.

The different components of weather parameters *e.g.* temperature (maximum and minimum), distribution of rainfall, relative humidity and sun shine hours recorded during the crop period *i.e.* from October, 2016 to April, 2017 have been graphically depicted in Fig. 1. During the crop season, the lowest temperature (4.9^0C) was recorded in the month of January and the maximum (39^0C) in the month of April. The total rainfall received was 7.57 mm during the entire crop season. The highest mean relative humidity (88.20%) was recorded in the month of January. The sun shine hours was found to vary from 1.0 to 9.1 hours.

The soil of the experimental field was classified as silty loam with alkaline reaction pH-8.1, which was low in organic carbon (0.34%), available nitrogen (185.4 kg ha^{-1}) and phosphorus (16.5kg ha^{-1}) and medium in potassium (240.1kg ha^{-1}). Land was prepared thoroughly to obtain fine soil tilth, pre-sowing irrigation was given to the field about 15 days prior to the sowing of the experimental crop. First ploughing was done by tractor drawn soil turning plough in order to get field free from weeds and crop stubbles. After 3-4 days, two ploughing were given deeply by tractor drawn cultivator followed by harrowing. Planking was done invariably after each ploughing. The field was free from clods, weeds and properly leveled for effective distribution of irrigation water. Well rotten FYM was applied before deep ploughing as per the treatments. The quantity of FYM was calculated on basis of nitrogen content. Poultry manure was applied before deep ploughing as per the treatments. The quantity of Poultry manure was calculated also on basis of nitrogen content. In case of fertilizers nitrogen and phosphorus were applied in the forms of Urea, and SSP. Full dose of nitrogen and phosphorus were applied at the time of sowing and nitrogen given as a starter dose in berseem crop. Berseem seeds treated with Rhizobiumtrifolli @ 250 g kg^{-1} seed along with jiggery @ 150 g kg^{-1} dissolve in 1-1.5 liter water and then uniformly spread over the seeds after 10 to 15 minute dried in shed. The seeds were sown on 2 November, 2016.Sowing was done by broadcasting with a 3-4 cm depth. A certified seed was used of cv. mescavi @ 30 kg ha^{-1} in all the plots.

Seed germination test

Hundred seeds of berseem (var. mescavi) were tested to determine the germination percentage. Germination of seeds was done by seed germinator under laboratory condition and germination percentage was calculated. It was observed that 80% seeds were germinated.

$$\text{Germination (\%)} = \frac{\text{No. of germinated seed}}{\text{No. of total seed}} \times 100$$

The cutting was done leaving half meter length from each side to avoid border effect. First cut of berseem was taken up at 55 DAS and subsequent cutting were taken at 35 days intervals. Stubble is leaving at the height of 3-4 cm after each cutting for better regenerate of plants.

Results and discussion

The maximum plant height and fresh weight of leaf at different cutting stages was recorded with the application of 100% RDF (20 kg N + 80 kg P_2O_5 ha^{-1}), which was statistically at par with 75% RDF +25% N through poultry manure, 75% RDF +25% N through FYM and 50% RDF +50% N through poultry manure, respectively. While the significantly higher over rest of the treatments. This might be due to more assimilation and utilization of available nitrogen and phosphorus by the growing plants during the entire grand growth period due to more time duration availability for regenerated crop, as the results of increase the plant height and fresh weight of leaf Valiki *et al*. (2015) [11]

Fresh weight of stem and dry weight of leaf at I^{st}, II^{nd}, III^{rd} and IV^{th} cut was significantly influenced by integrated nutrient management. The maximum fresh weight of stem was recorded with the application of 100% RDF (20 kg N +80 Kg P_2O_5 ha^{-1}) compared to other treatments Table 2. This might be due to nutrient supply through chemical fertilizers results plant uptake direct nutrient in soluble form due to which enhanced chlorophyll content by leaf thus enhanced the fresh weight of plant. The minimum fresh weight of stem was observed with control treatment. This might be due to lack of nutrients available in the soil. The similar results were obtained also Soleymani and Shahrajabian (2012) [9].

Integrated nutrient management significantly affected on dry weight of stem under various treatments. The maximum dry weight of stem at I^{st} cut, II^{nd} cut, III^{rd} cut and IV^{th}cut was recorded with T_2 -100% RDF (20 kg N +80 Kg P_2O_5) compare to other treatment at all cutting stages Table 3. It may be favorable synthesis of growth favoring constituent in plant system owing to better supply of nutrient due to highest production of dry weight of stem Subrata and Chakraborthy (1998).Shoot to root ratio was found significant at I^{st} cut and IV^{th} cut, while at II^{nd} cut and III^{rd} cut was not significantly affected by various treatment. The maximum shoot to root ratio at I^{st} cut, and IV^{th}cut was recorded with 100% RDF (20 kg N +80 Kg P_2O_5 ha^{-1}) compare to other treatment Table 3. At II^{st} cut and III^{rd} cut shoot and root of plant both gradually increase as same ratio so shoot to root ratio did not influence significantly by various treatment but at IV^{th} cut less of availability nutrient shoot mass did not increase more, Jan *et al*. (2014) [3] and Roy *et al*. (2015) [6].

The maximum No. of nodules per plant was found under

treatment 75% RDF + 25% N through Poultry Manure followed by 75% RDF + 25% N through FYM (Table 4). Similarly result was found by Kumar *et al*. (2007) [4]. It might be due to application of organic manure provide favorable condition for nodulation in berseem. The minimum number of nodules per plant was found with control treatment at different cutting stages of berseem crop, also reported by Taneja *et al*. (1994).

Table 1: Plant height (cm) and fresh weight of leaf (g m^{-2}) at different cutting stages of berseem as influenced by integrated nutrient management (INM)

S. No	Treatments	Plant height at I cut after 55 DAS	Subsequent plant height at 35 days intervals	Fresh weight of leaf at I cut after 55 DAS	Subsequent fresh weight of leaf at 35 days intervals	Fresh weight of leaf at I cut after 55 DAS	Subsequent fresh weight of leaf at 35 days intervals		
			II cut	III cut	IV cut		II cut	III cut	IV cut
1.	Control	28.3	31.4	35.0	30.2	250.9	404.0	444.2	298.9
2.	100% RDF (20 kg N ha-1; 80 kg P2O5 ha-1)	46.9	51.9	58.4	51.4	536.7	837.7	916.9	640.3
3.	100% N through Farm Yard Manure (FYM)	34.8	38.5	43.2	37.6	327.5	566.6	671.0	420.9
4.	100% N through Poultry Manure	38.1	42.1	47.4	43.2	376.4	633.1	666.8	418.5
5.	50% RDF +50% N through FYM	40.9	47.1	53.3	45.4	455.9	690.4	746.8	495.4
6.	50% RDF +50% N through Poultry Manure	42.1	48.8	54.5	48.1	470.6	730.6	802.6	517.3
7.	50% N through FYM+50% N through Poultry Manure	36.8	40.8	45.5	39.9	356.7	592.0	635.5	407.6
8.	50% RDF +25%N through FYM +25% N through Poultry Manure	41.2	46.1	51.6	45.4	466.9	715.9	778.7	514.0
9.	75% RDF +25% N through FYM	44.9	49.7	55.8	49.1	498.6	779.1	837.5	585.0
10.	75% RDF +25% N through Poultry Manure	45.6	50.5	56.4	50.9	519.9	815.9	876.1	619.3
11.	25% RDF +75% N through FYM	38.7	43.9	49.0	43.1	401.3	655.7	707.8	452.9
12.	25% RDF +75% N through Poultry Manure	39.9	45.2	50.7	44.5	417.3	684.4	737.2	480.6
13.	SEM±	1.85	1.57	1.58	1.95	17.26	23.46	30.50	18.96
14.	CD at 5%	5.44	4.61	4.62	5.72	50.61	68.73	89.43	55.60

Table 2: Fresh weight of stem (g m^{-2}) and dry weight of leaf (gm^{-2}) at different cutting stages of berseem as influenced by integrated nutrient management (INM)

S. No.	Treatments	Fresh weight of stem at I cut after 55 DAS	Subsequent fresh weight of stem at 35 days intervals	Dry weight of leaf at I cut after 55 DAS	Subsequent dry weight of leaf at 35 days intervals	Dry weight of leaf at I cut after 55 DAS	Subsequent dry weight of leaf at 35 days intervals		
			II cut	III cut	IV cut		II cut	III cut	IV cut
1	Control	369.1	545.9	643.7	453.0	26.3	51.0	57.7	40.3
2	100% RDF (20 kg N ha-1; 80 kg P2O5 ha-1)	735.3	1060.3	1239.1	901.8	54.0	102.7	114.3	83.3
3	100% N through Farm Yard Manure (FYM)	481.6	745.5	931.9	619.1	33.3	68.3	85.7	56.0
4	100% N through Poultry Manure	553.6	832.9	939.2	624.6	38.0	76.0	84.7	55.3
5	50% RDF +50% N through FYM	642.1	896.6	1037.2	707.6	45.7	82.0	94.0	65.0
6	50% RDF +50% N through Poultry	653.0	961.4	1099.4	749.7	47.7	88.0	101	67.7

	Manure								
7	50% N through FYM+50% N through Poultry Manure	524.4	800.0	870.5	608.4	36.0	71.0	81.3	54.3
8	50% RDF +25%N through FYM +25% N through Poultry Manure	647.0	942.1	1112.4	744.9	46.7	86.0	98.0	67.3
9	75% RDF +25% N through FYM	702.3	1011.8	1179.5	830.0	50.3	93.7	104.7	76.9
10	75% RDF +25% N through Poultry Manure	722.1	1046.1	1233.9	884.7	52.3	97.0	109.3	80.3
11	25% RDF +75% N through FYM	581.7	874.3	983.1	666.1	40.7	80.3	90.0	59.7
12	25% RDF +75% N through Poultry Manure	604.7	912.6	1023.8	717.4	42.3	83.0	93.0	63.3
13	SEM±	27.20	38.56	37.83	32.92	2.03	3.22	3.91	2.23
14	CD at 5%	79.76	113.09	110.94	96.56	5.96	9.44	11.46	6.55

Table 3: Dry weight of stem (gm^{-2}) and leaf: stem ratio $plant^{-1}$at different cutting stages of berseem as influenced by integrated nutrient management (INM)

S. No.	Treatments	Dry weight of stem at I cut after 55 DAS	Subsequent dry weight of stem at 35 days intervals	Shoot: Root ratio at I cut after 55 DAS	Subsequent Shoot: Root ratio at 35 days intervals	Shoot: Root ratio at I cut after 55 DAS	Subsequent Shoot: Root ratio at 35 days intervals		
			II cut	III cut	IV cut		II cut	III cut	IV cut
1.	Control	72.0	118.3	143.3	105.7	9.78	10.94	10.84	8.59
2.	100% RDF (20 kg N ha-1; 80 kg P2O5 ha-1)	138.3	228.0	269.0	203.7	12.98	12.12	12.00	11.81
3.	100% N through Farm Yard Manure (FYM)	92.0	157.0	206.7	143.0	9.98	10.92	10.62	8.78
4.	100% N through Poultry Manure	105.3	175.3	207.7	143.7	11.07	10.94	10.68	9.73
5.	50% RDF +50% N through FYM	121.3	189.3	227.0	161.3	12.15	11.65	11.46	10.67
6.	50% RDF +50% N through Poultry Manure	122.4	203.7	223.7	169.3	12.36	11.97	11.75	10.86
7.	50% N through FYM+50% N through Poultry Manure	99.7	168.0	192.3	140.0	10.42	11.02	10.85	9.16
8.	50% RDF +25%N through FYM +25% N through Poultry Manure	121.9	197.0	226.7	169.7	11.93	11.50	11.26	10.48
9.	75% RDF +25% N through FYM	132.0	216.3	257.3	188.3	12.49	12.36	12.16	11.24
10.	75% RDF +25% N through Poultry Manure	135.7	223.7	268.0	200.7	12.76	12.12	11.95	11.43
11.	25% RDF +75% N through FYM	110.3	185.0	216.3	152.3	11.29	11.28	11.08	9.92
12.	25% RDF +75% N through Poultry Manure	114.7	193.0	225.3	164.3	11.71	11.11	11.26	10.3
13.	SEM±	4.96	7.86	10.52	6.28	0.46	0.37	0.36	0.31
14.	CD at 5%	14.56	23.04	31.86	18.4	1.36	NS	NS	0.91

Table 4: No. of nodules plant^{-1} at different cutting stages of berseem as influenced by integrated nutrient management (INM)

S. No.	Treatments	No. of nodules plant-1 at I cut after 55 DAS	Subsequent no. of nodules plant-1at 35 days intervals		
			II cut	III cut	IV cut
1.	Control	49.0	73.9	79.9	53.2
2.	100% RDF (20 kg N ha-1; 80 kg P2O5 ha-1)	77.7	102.8	108.6	82.3
3.	100% N through Farm Yard Manure (FYM)	72.1	96.8	101.8	76.7
4.	100% N through Poultry Manure	68.6	92.0	99.1	73.7
5.	50% RDF +50% N through FYM	70.7	96.1	100.2	74.2
6.	50% RDF +50% N through Poultry Manure	76.3	102.0	106.9	81.3
7.	50% N through FYM+50% N through Poultry Manure	65.8	90.3	96.6	69.6
8.	50% RDF +25%N through FYM +25% N through Poultry Manure	74.2	99.6	107.9	80.0
9.	75% RDF +25% N through FYM	80.5	103.9	112.5	85.2
10.	75% RDF +25% N through Poultry Manure	81.2	107.4	118.8	85.6
11.	25% RDF +75% N through FYM	60.2	85.4	90.3	64.3
12.	25% RDF +75% N through Poultry Manure	63.7	88.3	91.9	69.6
13.	SEM±	2.78	3.32	4.09	2.64
14.	CD at 5%	8.14	9.74	12.02	7.73

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