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RESEARCH ARTICLE

Effect of integrated nutrient management on growth, herb yield and quality of alfalfa during *Rabi* season under central dry zone of Karnataka

■ **Nagappa Desai, A.P. Mallikarjuna Gowda and T.S. Sukanya**

SUMMARY

The experiment was conducted to study the effect of integrated nutrient management on growth, herb yield and quality of alfalfa (*Medicago sativa* L.) at the farm field of Krishi Vigyan Kendra, Konehalli, Tiptur, Tumkuru district under Central dry zone (Zone-4) of Karnataka state during *Rabi* seasons. The results revealed that the maximum plant height at 30 DAS (43.12 cm), first (85.63 cm), second (86.00 cm), third (92.10 cm), fourth (95.45 cm), fifth (92.30 cm), sixth (88.90 cm) and seventh harvest (86.79 cm) during *Rabi* season was recorded, when plants were supplied with 50 % RDF + 25 % N through vermicompost + *Rhizobium* + PSB + VAM. The least plant height was recorded with the application of 10 t/ha FYM + 100 % N through FYM at 30 DAS and all the harvests. The similar results were recorded the maximum number of branches and leaves per plant with application of the 50 % RDF + 25 % N through vermicompost + *Rhizobium* + PSB + VAM. The maximum fresh and dry herb yield per hectare was recorded at first (178.70 q and 26.30 q), second (213.89 q and 31.44 q), third (217.13 q and 31.94 q), fourth (218.98 q and 33.08 q), fifth (216.20 q and 31.81 q), sixth (208.33 q and 30.65 q) and seventh harvest (200.00 q and 29.40 q), respectively during *Rabi* season with the application of 50 % RDF + 25 % N through vermicompost + *Rhizobium* + PSB + VAM. Whereas, the lowest fresh and dry herb yield per hectare was recorded, when plants supplied with 10 t/ha FYM + 100 % N through FYM at all the harvests. The pants received with 50 % RDF + 25 % N through vermicompost + *Rhizobium* + PSB + VAM has resulted maximum nitrogen content of plant at first (1.15 %), second (1.14 %), third (1.15 %), fourth (1.12 %), fifth (1.09 %), sixth (1.06 %) and seventh harvest (1.05 %) during *Rabi* season, which was at par with the application of 50 % RDF + 25 % N through poultry manure + *Rhizobium* + PSB + VAM at first and third harvests. The application of 10 t/ha FYM + 100 % N through FYM recorded lowest nitrogen content of plant in at all the harvests. Therefore, 50 % RDF + 25 % N through vermicompost + *Rhizobium* + PSB + VAM may be recommended for commercial cultivation of alfalfa during *Rabi* season under central dry zone of Karnataka.

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Alfalfa (*Medicago sativa* L.) is one of the oldest cultivated perennial fodder crop in the world and supplies green fodder continuously for 2-3 years. It belongs to the family Fabaceae (Leguminaceae) and considered as Queen of the fodder crops' and also known as Lucerne. It is native of temperate regions of South-West Asia and it was introduced to Greece during 500 BC and from their spread to Italy and America. It was introduced to India from North-West in 1900 (Ahlawat *et al.*, 2007). It has now become very popular forage crop and growing successfully even in most of the tropical countries. In India, alfalfa is third most important forage crop, cultivated approximately in an area of one million hectare, with annual production of 60 to 130 tonnes of green forage per hectare and seed yield of 186 - 280 kg per hectare. It is grown in Punjab, Haryana, Uttar Pradesh, Gujarat, Maharashtra, Tamil Nadu and Karnataka. In Karnataka, it is locally known as 'Kudure masale'

Among the various cultural practices, nutrient management plays an important role in enhancing the yield of the crop. The adverse effect of continuous use of high dose of chemical fertilizers has resulted in deterioration of soil health and environment. The standardization of optimum dose of fertilizers to increase the production potential is need of the hour. Integrated nutrient management involves both organic and inorganic source of nutrition for biomass production and preserve the quality of plant products. The use of organic manures and biofertilizers along with balanced use of inorganic fertilizers is one of the eco-friendly approaches, which can be incorporated to attain higher crop productivity and sustainability (Singh *et al.*, 2015). The judicious combination of nutrient source becomes an important aspect of environmentally, eco-friendly agriculture, which prevents the pollution of environment and ground water contamination.

Considering the importance of crop and role of INM, the present investigation was carried out at the farm field of Krishi Vigyan Kendra, Konehalli, Tiptur, Tumkuru district, Karnataka state to assess the "effect of integrated nutrient management on growth, herb yield and quality of alfalfa (*Medicago sativa* L.)" with the following objectives :

Objectives :

– To assess the effect of integrated nutrient management on growth and herb yield of alfalfa

– To know the effect of integrated nutrient management on quality of alfalfa

MATERIAL AND METHODS

A field experiment was conducted to study the effect of integrated nutrient management on growth, herb yield and quality of alfalfa (*Medicago sativa* L.) at the farm field of Krishi Vigyan Kendra, Konehalli, Tiptur, Tumkuru district under Central dry zone (Zone-4) of Karnataka state during *Rabi* seasons from October 2016 to July 2017. The soil status of experiment plot was red sandy loam. There were nine treatments and four replication with Randomized Complete Block Design (RCBD). Alfalfa seeds (variety T-9) were treated with bio-fertilizers *viz*., *Rhizobium meliloti* and applied phosporus solubalizing bacteris (PSB) and vascular arabascular mycorhiza (VAM) along with organic manures. The seeds were sown during *Rabi* season (3rd October 2017) with 30 cm x 15 cm spacing. Observations were recorded on various growth, herb yield and quality parameter. The treatment details as mentioned below.

Treatment details :

T_1 : Rec. dose of fertilizer (25:50:25 kg NPK/ha + 10 t/ha FYM)

T_2 : 75% RDF + 25% N through FYM

T_3 : 75% RDF + 25% N through vermicompost

T_4 : 75% RDF + 25% N through poultry manure

T_5 : 50% RDF + 25% N through FYM + *Rhizobium* + PSB+VAM

T_6 : 50% RDF + 25% N through vermicompost+ *Rhizobium* + PSB+VAM

T_7 : 50% RDF + 25% N through poultry manure+ *Rhizobium* + PSB+VAM

T_8 : RDF + *Rhizobium* + PSB+VAM

T_9 : 10 t/ha FYM + 100% N through FYM

Note: The first crop was harvested at 60 days after sowing and six ratoon crops were harvested at 30 days interval at flower initiation stage.

RESULTS AND DISCUSSION

The results on influence of integrated nutrient management on growth, herb yield and quality of alfalfa during *Rabi* season are presented here under.

Effect of integrated nutrient management on growth parameters :

The data on plant height, number of branches and

leaves at 30 DAS, first harvest and subsequent harvesting of ratoon crops during *Rabi* season as effected by INM are presented in Table 1, 2 and 3.

The maximum plant height at 30 DAS (43.12 cm), first (85.63 cm), second (86.00 cm), third (92.10 cm), fourth (95.45 cm), fifth (92.30 cm), sixth (88.90 cm) and seventh harvest (86.79 cm) during *Rabi* season was recorded, when plants were supplied with 50 % RDF + 25 % N through vermicompost + *Rhizobium* + PSB + VAM, which was at par with all the harvests except at first, second and fourth harvest, when plants were supplied with RDF + 25 % N through poultry manure + *Rhizobium* + PSB + VAM. The least plant height was recorded during *Rabi* season with the application of 10 t/ha FYM + 100 % N through FYM at 30 DAS and all the harvests.

The increased plant height could be attributed to the application of vermicompost, which has rich source of nutrients, vital plant promoting and humus forming substances, N-fixers and other beneficial micro-organisms helped for building up of cells, thus better growth was observed. The bio-fertilizers have also enhanced the availability of nutrients through atmospheric nitrogen fixation and phosphorus mobilization. The results obtained are in conformity with the findings of Kayina and Reddy (2012) in senna, Sunanda *et al*. (2014) in kasuri methi, Devkota and Jha (2013) in centella and Kalyanasundaram *et al*. (2008) in sweet flag

The application of 50 % RDF + 25 % N through vermicompost + *Rhizobium* + PSB + VAM has recorded maximum number of branches per plant at 30 DAS (12.05), first (21.56), second (27.42), third (29.10), fourth (31.45), fifth (30.24), sixth (28.76) and seventh harvest (26.34) during *Rabi* season was recorded, which was at

Table 1: Effect of integrated nutrient management on plant height of alfalfa during *Rabi* season

Treatments	Plant height (cm)							
	30 DAS	I Harvest	II Harvest	III Harvest	IV Harvest	V Harvest	VI Harvest	VII Harvest
T_1	40.76	80.86	82.30	87.64	89.85	88.83	84.42	80.31
T_2	37.82	78.90	80.35	84.28	85.61	84.32	80.69	77.65
T_3	39.63	79.73	81.90	86.75	88.50	86.55	82.30	79.42
T_4	39.10	79.00	81.05	86.26	87.90	86.55	82.24	79.38
T_5	42.19	83.53	84.13	90.79	93.64	91.20	86.45	84.58
T_6	43.12	85.63	86.00	92.10	95.45	92.30	88.90	86.79
T_7	42.65	85.00	84.48	91.54	94.38	91.60	87.85	86.31
T_8	41.86	82.75	83.74	88.90	91.94	90.12	85.10	82.12
T_9	36.10	76.63	78.80	82.10	83.62	82.50	78.20	75.80
F- test	*	*	*	*	*	*	*	*
S.E.±	0.16	0.17	0.53	0.32	0.34	0.26	0.72	0.67
C.D. (P=0.05)	0.49	0.51	1.55	0.96	1.01	0.75	2.10	1.98

DAS: Days after sowing

Table 2 : Influence of integrated nutrient management on number of branches in alfalfa during *Rabi* season

Treatments	Number of branches per plant							
	30 DAS	I Harvest	II Harvest	III Harvest	IV Harvest	V Harvest	VI Harvest	VII Harvest
T_1	10.45	19.10	24.79	24.80	27.41	26.80	25.56	23.80
T_2	9.45	17.86	22.60	22.90	25.80	24.38	23.79	21.98
T_3	10.11	18.95	23.54	23.62	26.10	25.42	24.85	22.49
T_4	10.04	18.94	23.54	23.59	26.10	25.43	24.85	22.50
T_5	11.95	20.04	26.98	27.80	29.90	28.70	26.90	25.56
T_6	12.05	21.56	27.42	29.10	31.45	30.24	28.76	26.34
T_7	11.56	20.15	27.10	28.50	31.05	29.60	28.02	26.10
T_8	10.80	19.89	25.90	26.34	29.12	27.95	26.10	24.32
T_9	9.15	17.04	22.15	22.52	25.52	24.17	24.10	21.54
F- test	*	*	*	*	*	*	*	*
S.E.±	0.45	0.48	0.21	0.36	0.50	0.31	0.50	0.24
C.D. (P=0.05)	1.31	1.21	0.62	1.08	1.45	0.90	1.47	0.70

DAS: Days after sowing

par with the application of 50 % RDF + 25 % N through poultry manure + *Rhizobium* + PSB + VAM at 30 DAS and all the harvests at except first harvest. The least number of branches per plant was recorded with the application of 10 t/ha FYM + 100 % N through FYM during *Rabi* season at 30 DAS and all the harvests.

Among the different treatments, the application of 50 % RDF + 25 % N through vermicompost + *Rhizobium* + PSB + VAM has recorded maximum number of leaves per plant at 30 DAS (95.45), first (229.56), second (305.34), third (312.53), fourth (316.42), fifth (308.80), sixth (302.80) and seventh harvest (284.40) during *Rabi* season, which was at par with all the harvests with the application of 50 % RDF + 25 % N through poultry manure + *Rhizobium* + PSB + VAM. The application of 10 t/ha FYM + 100 % N through FYM recorded with the least number of leaves per plant at 30 DAS and all the harvests during *Rabi* season.

The increased number of branches and leaves might be due to supply of nutrients through organic, inorganic and bio-fertilizers, which has enhanced the metabolic activity of plant by increasing cell division and cell elongation as results in maximum plant height with more number of branches and leaves. These findings are in line with those of Patil *et al.* (2014); Nadukeri (2010) and Karad *et al.* (2009) in ashwagandha, Gudade (2013) in kalmegh, Singh *et al.* (2012) in coleus, Yeboah *et al.* (2012) in sweet worm wood and Rasmia *et al.* (2009) in periwinkle.

Effect of integrated nutrient management on herb yield :

Table 3: Number of leaves in alfalfa as influenced by integrated nutrient management during *Rabi* season

Treatments	Number of leaves per plant							
	30 DAS	I Harvest	II Harvest	III Harvest	IV Harvest	V Harvest	VI Harvest	VII Harvest
T_1	87.21	215.90	289.60	298.18	299.80	295.40	288.70	270.62
T_2	82.80	204.56	273.64	288.58	290.57	285.90	278.28	261.76
T_3	85.70	210.50	283.80	295.12	295.30	291.75	283.14	266.86
T_4	84.90	208.43	279.41	294.10	295.32	288.74	283.10	266,88
T_5	92.70	224.60	297.32	307.34	308.70	302.61	296.65	279.90
T_6	95.45	229.56	305.34	312.53	316.42	308.80	302.80	284.40
T_7	94.23	227.80	301.90	310.45	312.84	306.45	300.64	282.45
T_8	90.50	219.23	293.40	303.90	304.14	300.10	292.14	275.19
T_9	79.60	201.18	265.10	283.30	287.50	281.74	274.60	256.40
F- test	*	*	*	*	*	*	*	*
S.E.±	0.70	1.45	2.36	1.33	2.43	1.93	1.87	1.45
C.D. (P=0.05)	2.05	4.25	6.90	3.90	7.10	5.65	5.45	4.24

DAS: Days after sowing

Table 4 : Fresh and dry weight of plant in alfalfa as influenced by integrated nutrient management during *Rabi* season

Treatments	Fresh and dry weight of plant (g/plant)													
	I Harvest		II Harvest		III Harvest		IV Harvest		V Harvest		VI Harvest		VII Harvest	
	Fresh weight	Dry weight	Fresh weight	Dry weight	Fresh weight	Dry weight	Fresh weight	Dry weight	Fresh weight	Dry weight	Fresh weight	Dry weight	Fresh weight	Dry weight
T_1	137.88	22.52	179.12	27.61	181.55	27.75	184.34	28.22	175.27	27.63	167.64	25.63	159.50	25.16
T_2	127.74	20.86	169.55	26.49	171.86	27.03	173.97	26.78	165.75	25.50	157.73	24.46	149.14	22.94
T_3	133.04	21.66	174.14	27.16	176.18	27.68	178.15	28.06	169.96	26.14	164.13	24.99	154.70	23.80
T_4	131.78	21.44	174.16	27.07	175.94	27.37	178.20	27.88	169.93	26.15	161.70	25.04	154.64	23.76
T_5	146.58	23.96	185.49	28.98	189.68	29.82	191.62	30.14	183.46	28.23	176.92	27.19	167.76	25.80
T_6	152.49	24.94	191.75	29.92	195.10	31.46	197.47	32.21	188.85	29.05	183.85	28.11	174.38	26.83
T_7	150.96	24.65	190.16	29.63	192.87	31.10	194.39	30.91	187.16	29.02	180.18	27.74	171.75	26.42
T_8	142.57	23.20	182.83	27.92	185.66	30.52	188.11	28.87	179.08	28.23	172.60	26.49	164.21	25.26
T_9	124.87	20.34	166.00	25.43	167.37	25.74	169.95	26.27	162.30	24.98	155.73	23.94	145.68	22.40
F- test	*	*	*	*	*	*	*	*	*	*	*	*	*	*
S.E.±	1.76	0.33	1.75	0.31	1.37	0.45	6.21	0.65	1.74	0.22	2.09	0.32	2.16	0.35
C.D. (P=0.05)	5.15	0.96	5.11	0.91	4.01	1.31	2.12	1.90	5.10	0.65	6.11	0.92	6.31	1.02

Fresh and dry weight of plant (g) :

The data on fresh and dry weight of plant at first and subsequent harvesting of ratoon crops during *Rabi* season as effected by INM are presented in Table 4. The application of 50 % RDF + 25 % N through vermicompost + *Rhizobium* + PSB + VAM has resulted maximum fresh weight of plant at first (152.49 g), second (191.75 g), third (195.10 g), fourth (197.47 g), fifth (188.85 g), sixth (183.85 g) and seventh harvest (174.38 g) during *Rabi* season, which was at par with the application of 50 % RDF + 25 % N through poultry manure + *Rhizobium* + PSB + VAM at all the harvests. The lowest fresh weight of plant was recorded with the application of 10 t/ha FYM + 100 % N through FYM during *Rabi* season at all the harvests.

Among the different treatments, the maximum dry weight of plant was recorded at first (24.94 g), second (29.92 g), third (31.46 g), fourth (32.21 g), fifth (29.05 g), sixth (28.11 g) and seventh harvest (26.83 g) during *Rabi* season, when plants were supplied with 50 % RDF + 25 % N through vermicompost + *Rhizobium* + PSB + VAM, which was at par with the application of 50 % RDF + 25 % N through poultry manure + *Rhizobium* + PSB + VAM at all the harvest. The application of 10 t/ ha FYM + 100 % N through FYM recorded least dry weight of plant at all the harvests during *Rabi* season.

The increased fresh and dry weight of plant might be attributed to better availability of nutrients and creation of congenial condition in the vicinity of root zone by bio-fertilizers, with which the plants absorbed more of nutrients and enhanced the synthesis of carbohydrates and utilized for building up of new cell. These findings are in line with Rajamanickam *et al.* (2011) in mint, Ajimoddin *et al.* (2005) in sweet basil, Shirole *et al.* (2005) in brahmi, Subodhini *et al.* (2005) in centella and Kumaravel (2003) in sweet worm wood.

Fresh and dry herb yield per hectare (q) :

The data on fresh and dry herb yield per hectare at first and subsequent harvesting of ratoon crops during *Rabi* season as effected by INM are presented in Table 5. The plants supplied with 50 % RDF + 25 % N through vermicompost + *Rhizobium* + PSB + VAM has resulted maximum fresh herb yield per hectare at first (178.70 q), second (213.89 q), third (217.13 q), fourth (218.98 q), fifth (216.20 q), sixth (208.33 q) and seventh harvest (200.00 q) during *Rabi* season, which was at par with the application of 50 % RDF + 25 % N through poultry manure + *Rhizobium* + PSB + VAM at all the harvests. The application of 10 t/ha FYM + 100 % N through FYM recorded least fresh herb yield per hectare during *Rabi* season at all the harvests.

The maximum dry herb yield per hectare was recorded at first (26.30 q), second (31.44 q), third (31.94 q), fourth (33.08 q), fifth (31.81 q), sixth (30.65 q) and seventh harvest (29.40 q) during *Rabi* season with 50 % RDF + 25 % N through vermicompost + *Rhizobium* + PSB + VAM, which was at par with the application of 50 % RDF + 25 % N through poultry manure + *Rhizobium* + PSB + VAM at all the harvests except at fourth harvest. The lowest dry herb yield per hectare was recorded with the application of 10 t/ha FYM + 100

Table 5: Effect of integrated nutrient management on fresh and dry herb yield in alfalfa during *Rabi* season

Treatments	Fresh and dry herb yield per hectare (q)															
	I Harvest		II Harvest		III Harvest		IV Harvest		V Harvest		VI Harvest		VII Harvest		Cumulative	
	Fresh weight	Dry weight	Fresh weight	Dry weight	Fresh weight	Dry weight	Fresh weight	Dry weight	Fresh weight	Dry weight	Fresh weight	Dry weight	Fresh weight	Dry weight	Fresh weight	Dry weight
T_1	172.22	24.95	206.48	29.91	208.33	30.18	210.65	30.51	209.26	30.32	202.31	29.31	193.05	27.96	1402.30	203.15
T_2	166.2	23.75	201.85	28.84	201.85	28.84	204.63	29.21	202.31	28.89	196.30	28.06	188.89	26.99	1362.03	194.58
T_3	169.91	24.44	204.17	29.40	206.02	29.63	208.33	29.95	206.48	29.72	200.46	28.84	191.67	27.59	1387.04	199.58
T_4	168.52	24.12	203.24	29.12	204.17	29.26	206.48	29.58	205.09	29.39	199.07	28.52	191.20	27.41	1377.77	197.41
T_5	175.46	25.56	211.11	30.79	213.42	31.11	216.67	31.57	213.89	31.16	205.55	29.95	197.22	28.75	1433.32	208.90
T_6	178.70	26.30	213.89	31.44	217.13	31.94	218.98	33.08	216.20	31.81	208.33	30.65	200.00	29.40	1453.23	213.76
T_7	177.78	26.06	212.50	31.16	215.28	31.57	218.52	32.04	215.28	31.57	207.41	30.42	199.07	29.18	1445.84	211.99
T_8	174.07	25.32	208.79	30.37	211.11	30.69	213.89	31.11	211.57	30.74	203.70	29.67	194.91	28.33	1399.52	203.47
T_9	162.04	23.02	199.07	28.24	199.54	28.29	201.39	28.56	200.46	28.43	193.52	27.45	186.11	26.39	1342.13	190.32
F- test	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
S.E.±	1.06	0.71	0.86	0.19	1.32	0.28	0.72	0.22	0.79	0.18	0.94	0.21	0.94	0.20	6.50	1.46
C.D. (P=0.05)	3.10	0.24	2.50	0.57	3.85	0.84	2.11	0.64	2.05	0.54	2.73	0.62	2.76	0.61	19.10	4.25

% N through FYM during *Rabi* season at all the harvests.

The maximum fresh and dry herb yield may be due to the reason that vermicompost is known to produce favourable effect on physical, chemical and biological factors that determines the productivity and fertility status of soil and supplies nutrients in their available form, increases the microbial population and provides sufficient energy for them to remain active. It also provides the vital macro-nutreint such as N, P, K, Ca, Mg and micro-nutrients. Besides, *Rhizobium* has increased the availability of nitrogen and helped in the synthesis of tryptophan, which is a precursor for the biosynthesis of auxins and hastened the metabolic activities in the plant resulting in maximum plant height, branches and number of leaves, thus maximum herb yield was obtained. The similar reports were found with Vijay *et al.* (2015); Vishal and Duhan (2013) and Makwana (2010) in kalmegh, Gupta, *et al.* (2011) in black henbane, Ravirajashetty *et al.* (2014) in davana, Raju *et al.* (2014), Sivakumar *et al.* (2011) in ashwagandha, Shivanna *et al.* (2007) and Pushpalatha *et al.* (2003) in makoi, Ali *et al.* (2012) in chicory, Sanjutha *et al.* (2008) in kalmegh, Mahfouz and Sharaf-Eldin (2007) in fennel, Chand *et al.* (2001) and Sukhmal *et al.* (2001) in menthol mint.

Table 6 : Influence of integrated nutrient management on nitrogen and crude protein content of plant in alfalfa during *Rabi* season

Treatments	Nitrogen and crude protein content in plant (%)													
	I Harvest		II Harvest		III Harvest		IV Harvest		V Harvest		VI Harvest		VII Harvest	
	N Content	Crude protein content	N Content	Crude protein content	N Content	Crude protein content	N Content	Crude protein content	N Content	Crude protein content	N Content	Crude protein content	N Content	Crude protein content
T_1	1.09	6.81	1.10	6.88	1.08	6.75	1.06	6.63	1.06	6.63	1.03	6.44	1.01	6.31
T_2	1.05	6.56	1.07	6.69	1.06	6.63	1.04	6.5	1.04	6.50	1.01	6.31	0.98	6.13
T_3	1.07	6.69	1.08	6.75	1.07	6.69	1.05	6.56	1.05	6.56	1.02	6.38	1.00	6.25
T_4	1.06	6.63	1.08	6.75	1.06	6.63	1.04	6.50	1.04	6.50	1.02	6.38	0.99	6.19
T_5	1.13	7.06	1.12	7.00	1.12	6.94	1.08	6.75	1.08	6.75	1.04	6.50	1.03	6.44
T_6	1.15	7.14	1.14	7.10	1.15	7.13	1.12	6.88	1.09	6.81	1.06	6.63	1.05	6.56
T_7	1.14	7.13	1.13	7.06	1.14	6.94	1.09	6.81	1.08	6.75	1.05	6.56	1.04	6.50
T_8	1.11	6.94	1.11	6.94	1.10	6.88	1.07	6.69	1.07	6.69	1.03	6.44	1.03	6.44
T_9	1.04	6.50	1.06	6.63	1.03	6.44	1.02	6.38	1.02	6.38	1.00	6.25	0.96	6.00
F- test	*	*	*	*	*	*	*	*	*	*	*	*	*	*
S.E.±	0.007	0.02	0.002	0.04	0.004	0.02	0.007	0.03	0.003	0.02	0.001	0.03	0.002	0.03
C.D. (P=0.05)	0.020	0.06	0.006	0.12	0.012	0.05	0.020	0.09	0.009	0.05	0.003	0.10	0.006	0.08

Table 7 : Phosphorus and potassium content of plant in alfalfa as effected by integrated nutrient management during *Rabi* season

Treatments	Phosphorus and potassium content in plant (%)													
	I Harvest		II Harvest		III Harvest		IV Harvest		V Harvest		VI Harvest		VII Harvest	
	P Content	K Content	P Content	K Content	P Content	K Content	P Content	K Content	P Content	K Content	P Content	K Content	P Content	K Content
T_1	0.45	0.80	0.41	0.79	0.40	0.78	0.36	0.76	0.34	0.74	0.33	0.70	0.27	0.69
T_2	0.43	0.77	0.39	0.77	0.38	0.76	0.34	0.74	0.32	0.72	0.31	0.68	0.25	0.66
T_3	0.44	0.79	0.40	0.79	0.39	0.77	0.35	0.75	0.33	0.73	0.32	0.69	0.26	0.68
T_4	0.43	0.78	0.40	0.78	0.39	0.76	0.34	0.75	0.32	0.73	0.31	0.69	0.26	0.67
T_5	0.47	0.81	0.43	0.80	0.41	0.79	0.37	0.78	0.35	0.76	0.34	0.71	0.29	0.70
T_6	0.48	0.83	0.44	0.82	0.43	0.81	0.39	0.79	0.37	0.77	0.36	0.73	0.30	0.71
T_7	0.47	0.82	0.43	0.81	0.42	0.80	0.38	0.78	0.36	0.76	0.35	0.72	0.29	0.70
T_8	0.46	0.80	0.42	0.80	0.41	0.79	0.37	0.77	0.35	0.75	0.34	0.71	0.28	0.69
T_9	0.42	0.76	0.38	0.76	0.37	0.75	0.33	0.73	0.31	0.71	0.30	0.67	0.24	0.65
F- test	*	--	*	--	*	--	*	--	*	--	*	--	*	--
S.E.±	0.13	0.09	0.15	0.11	0.14	0.14	0.16	0.11	0.15	0.11	0.13	0.09	0.14	0.10
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS=Non-significant

Effect of integrated nutrient management on plant quality parameter :

Nitrogen and crude protein content of plant :

The data on nitrogen and crude content of plant at first and subsequent harvesting of ratoon crops during *Rabi* season as influenced by INM are presented in Table 6. The pants received with 50 % RDF + 25 % N through vermicompost + *Rhizobium* + PSB + VAM has resulted maximum nitrogen content of plant at first (1.15 %), second (1.14 %), third (1.15 %), fourth (1.12 %), fifth (1.09 %), sixth (1.06 %) and seventh harvest (1.05 %) during *Rabi* season, which was at par with the application of 50 % RDF + 25 % N through poultry manure + *Rhizobium* + PSB + VAM at first and third the harvests. The application of 10 t/ha FYM + 100 % N through FYM recorded lowest nitrogen content of plant during *Rabi* season at all the harvests. The maximum nitrogen content may be due to maximum fixation of nitrogen by microbial inoculation of *Rhizobium* and supply of adequate nitrogen through vermicompost. The results of the present study are in agreement with those obtained by Sathyanarayana *et al.* (2015) in ajwain and Anwar *et al.* (2005) in french basil

The maximum crude protein content of plant was recorded at first (7.14 %) second (7.10 %), third (7.13 %), fourth (6.88 %), fifth (6.81 %), sixth (6.63 %) and seventh harvest (6.56 %) during *Rabi* season with 50 % RDF + 25 % N through vermicompost + *Rhizobium* + PSB + VAM, which was at par with the application of 50 % RDF + 25 % N through poultry manure + *Rhizobium* + PSB + VAM at all the harvests except third and fifth harvest. The application of 10 t/ha FYM + 100 % N through FYM recorded least crude protein content of plant during *Rabi* season at all the harvests. The increased crude protein content of plant may be attributed to higher level of nitrogen supplied through atmospheric nitrogen fixation and the application of vermicompost, which enhanced the maximum availability of nitrogen to the plant. Similar results were obtained in Chaichi *et al.* (2015) in berseem.

Phosphorus and potassium content of plant :

The data on phosphorus and potash content of plant at first and subsequent harvesting of ratoon crops during *Rabi* season were not significantly influenced by integrated nutrient management (Table 7).

Conclusion :

The study on integrated nutrient management growth, herb yield and quality of alfalfa (*Medicago sativa* L.) revealed that, the application of 50 % RDF + 25 % N through vermicompost + *Rhizobium* + PSB + VAM has recorded maximum growth, herb yield and quality of alfalfa during *Rabi* season. Therefore, 50 % RDF + 25 % N through vermicompost + *Rhizobium* + PSB + VAM may be recommended for commercial cultivation of alfalfa under central dry zone of Karnataka.

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