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Effect of integrated nutrient management on nutrient content and uptake in alfalfa under central dry zone of Karnataka

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Abstract
The experiment was conducted to study the effect of integrated nutrient management on nutrient content and uptake in alfalfa under central dry zone of Karnataka at the farm field of Krishi Vigyan Kendra, Konehalli, Tiptur, Tumkuru district of Karnataka state during *kharif* and *rabi* seasons from June 2016 to July 2017. There were nine treatments and four replication with Randomized complete block design. The results revealed that, the maximum nitrogen content of plant at first (1.14% & 1.15%), second (1.12% & 1.14%), third (1.16% & 1.15%), fourth (1.12% & 1.12%), fifth (1.11% & 1.09%), sixth (1.08% & 1.06%) and seventh harvest (1.07% & 1.05%) were recorded respectively during *kharif* and *rabi* season with the application 50% RDF+25% N through vermicompost+*Rhizobium*+PSB+VAM. The least nitrogen content of plant was recorded with the application of 10 t/ha FYM+100% N through FYM at all the harvests. The application of 50% RDF+25% N through vermicompost+*Rhizobium*+PSB+VAM has recorded maximum cumulative uptake of nitrogen (250.74 kg ha^{-1} & 235.36 kg ha^{-1}), phosphorus (91.47 kg ha^{-1} & 84.36 kg ha^{-1}) and potassium (176.46 kg ha^{-1} & 166.66 kg ha^{-1}) by plant respectively during *kharif* and *rabi* season. The highest crude protein content of plant at first and subsequent harvesting of ratoon crops were recorded with the application of 50% RDF+25% N through vermicompost+*Rhizobium*+PSB+VAM in both the season. The experiment concluded that, the application of 50% RDF+25% N through vermicompost+*Rhizobium*+PSB+VAM has recorded maximum nutrient content and uptake in alfalfa during *kharif* and *rabi* season under central dry zone of Karnataka.

Keywords: Alfalfa, herb, nutrient, uptake and season.

Introduction
Alfalfa (*Medicago sativa* L.) is one of the most important perennial fodder crop 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 spreader to Italy and America. It was introduced to India from North-West in 1900 (Ahlawa, 2007) [1]. 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'.

Alfalfa is relished by all kinds of livestock as it yields nutritious and palatable green fodder, which contains protein (13.3-26.6%), phosphorus (0.14–0.66%), calcium (0.92–2.9%), carotene (9.27 mg/100g), fibre (20-30%) and vitamin A and C (Khalak, 1989) [8]. It is important medicinal plant having stachydrine as alkaloid and used as laxative, digestive, diuretic and treating for dropsy, blood pressure, hair loss, acidity and arthritis. It is also used against high cholesterol, asthma, osteo-arthritis, diabetes, stomach problem and a bleeding disorder called thrombocytopenic purpura. The people also consume alfalfa as green leafy vegetable, which is the rich source of vitamins A, C, E, K_4, Niacin, Thiamin, Riboflavin; and minerals like calcium, potassium, phosphorous, Magnesium and iron.

The 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 of herb and seed yield. 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) [19]. 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 nutrient content and uptake in alfalfa under central dry zone of Karnataka"

Materials and Method

The two field experiment was conducted to study the effect of integrated nutrient management on nutrient content and uptake in alfalfa under central dry zone of Karnataka at the farm field of Krishi Vigyan Kendra, Konehalli, Tiptur, Tumkuru district under Central dry zone (Zone-4) of Karnataka state during *kharif* and *rabi* seasons from June 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 *Phosporous solubalizing bacteris (PSB) and vascular arabascular mycorhiza (VAM)* along with organic manures. The seeds were sown during *kharif* (1st week of June 2016) and *rabi* season (1st week of October 2017) with 30 cm x 15 cm spacing.

Treatment details for both the season

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

Table 1: Analysis of Farm yard manure, Vermicompost and Poultry manure for NPK content before conducting the experiment

Organic manures	N content (%)	P_2O_5 content (%)	K_2O content (%)
Farm yard manure	0.95	0.62	0.75
Vermicompost	1.60	0.86	0.98
Poultry manure	2.10	1.35	1.76

Details of observation recorded

The first crop was harvested at 60 days after sowing to a height of 5 cm from ground level and ratoon crops were harvested at 30 days interval at flower initiation stage for herbage yield. Whereas, for seed production, the first crop was harvested at 60 days after sowing and allowed it for further growth, flowering and to reach physiological maturity stage for obtaining the seeds.

Plant analysis

The five plants from each plot were analyzed for nitrogen, phosphorous and potassium and expressed in percentage. The uptake was calculated by multiplying with dry yield. The nitrogen content in the plant sample was determined using Micro-Kjeldhal digestion and distillation method, phosphorus content in plant by using vanadomolybdate phosphoric yellow colour method after digestion using di-acid and potassium content in plant by flame photometer method after digestion with di-acid (Piper, 1966) [13].

Nutrient uptake

The uptake of nitrogen, phosphorus and potassium was calculated by using the formula given below.

$$\text{Nutrient uptake (kg ha}^{-1}) = \frac{\text{Nutrient concentration (\%).} \times \text{Dry herb yield (kg ha}^{-1})}{100}$$

Crude protein content

The crude protein content in plant and seed materials on oven dry weight basis was worked out by using modified Kjeldahl's method (Jackson, 1967) [5]. The crude protein content in plant and seed was estimated by multiplying the nitrogen content with 6.25 and expressed in percentage.

Crude Protein (%) = Nitrogen (%) x 6.25

Results and Discussion

The results on influence of integrated nutrient management on nutrient content and uptake in alfalfa during *kharif* and *rabi* season are presented here under

Experiment - I: Effect of integrated nutrient management on nutrient content and uptake in plant

Influence of integrated nutrient management on nitrogen content of plant

The data on nitrogen content of plant at first and subsequent harvesting of ratoon crops during *kharif* and *rabi* season as influenced by INM are presented in Table 2. The maximum nitrogen content of plant was recorded at first (1.14%), second (1.12%), third (1.16%), fourth (1.12%), fifth (1.11%), sixth (1.08%) and seventh harvest (1.07%) during *kharif* season, when plants were supplied with 50% RDF+25% N through vermicompost+*Rhizobium*+PSB+VAM, which was *on par* with the application of 50% RDF+25% N through poultry manure+*Rhizobium*+PSB+VAM at all the harvests except at second, third and seventh harvest.

The application of 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 tha FYM+100% N through FYM recorded lowest nitrogen content of plant in both the 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 Khalid and Mahmoud (2015) [9] in black cumin, Sathyanarayana *et al*. (2015) [16] in ajwain, Dubey *et al*. (2012) [4] in fenugreek, Kalyanasundaram *et al*. (2008) [6] in sweet flag, Anwar *et al*. (2005) [2] in french basil and Omidbaigi and Aroiee (2004) [12] in medicinal pumpkin.

Effect of integrated nutrient management on phosphorus and potassium content of plant

The data on phosphorus and potassium content of plant at first and subsequent harvesting of ratoon crops during *kharif* and *rabi* season were not significantly influenced by integrated nutrient management (Table 3 & 4).

Table 2: Influence of integrated nutrient management on nitrogen content of alfalfa

Treatment	Nitrogen content (%)													
	I Harvest		II Harvest		III Harvest		IV Harvest		V Harvest		VI Harvest		VII Harvest	
	Kharif	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*
T_1	1.10	1.09	1.09	1.10	1.09	1.08	1.07	1.06	1.07	1.06	1.05	1.03	1.02	1.01
T_2	1.06	1.05	1.05	1.07	1.06	1.06	1.05	1.04	1.05	1.04	1.03	1.01	0.99	0.98
T_3	1.09	1.07	1.07	1.08	1.08	1.07	1.06	1.05	1.06	1.05	1.04	1.02	1.01	1.00
T_4	1.08	1.06	1.07	1.08	1.07	1.06	1.06	1.04	1.05	1.04	1.03	1.02	1.00	0.99
T_5	1.13	1.13	1.10	1.12	1.12	1.12	1.10	1.08	1.09	1.08	1.07	1.04	1.05	1.03
T_6	1.14	1.15	1.12	1.14	1.16	1.15	1.12	1.12	1.11	1.09	1.08	1.06	1.07	1.05
T_7	1.13	1.14	1.11	1.13	1.14	1.14	1.10	1.09	1.10	1.08	1.07	1.05	1.06	1.04
T_8	1.11	1.11	1.09	1.11	1.10	1.10	1.09	1.07	1.09	1.07	1.06	1.03	1.04	1.03
T_9	1.05	1.04	1.04	1.06	1.05	1.03	1.03	1.02	1.04	1.02	1.02	1.00	0.98	0.96
F- test	*	*	*	*	*	*	*	*	*	*	*	*	*	*
S. Em±	0.008	0.007	0.003	0.002	0.004	0.004	0.005	0.007	0.006	0.003	0.004	0.001	0.001	0.002
CD at 5%	0.023	0.020	0.009	0.006	0.012	0.012	0.015	0.020	0.018	0.009	0.012	0.003	0.003	0.006

Table 3: Effect of integrated nutrient management on phosphorus content of alfalfa

Treatment	Phosphorus content (%)													
	I Harvest		II Harvest		III Harvest		IV Harvest		V Harvest		VI Harvest		VII Harvest	
	Kharif	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*
T_1	0.43	0.45	0.44	0.41	0.39	0.40	0.38	0.36	0.37	0.34	0.32	0.33	0.30	0.27
T_2	0.41	0.43	0.42	0.39	0.37	0.38	0.36	0.34	0.35	0.32	0.30	0.31	0.28	0.25
T_3	0.42	0.44	0.43	0.40	0.38	0.39	0.38	0.35	0.36	0.33	0.31	0.32	0.29	0.26
T_4	0.42	0.43	0.43	0.40	0.38	0.439	0.37	0.34	0.35	0.32	0.30	0.31	0.28	0.26
T_5	0.44	0.47	0.45	0.43	0.40	0.41	0.39	0.37	0.38	0.35	0.34	0.34	0.31	0.29
T_6	0.46	0.48	0.47	0.44	0.42	0.43	0.41	0.39	0.40	0.37	0.35	0.36	0.33	0.30
T_7	0.45	0.47	0.46	0.43	0.41	0.42	0.40	0.38	0.39	0.36	0.34	0.35	0.32	0.29
T_8	0.44	0.46	0.45	0.42	0.40	0.41	0.39	0.37	0.37	0.35	0.33	0.34	0.31	0.28
T_9	0.40	0.42	0.41	0.38	0.36	0.37	0.35	0.33	0.34	0.31	0.29	0.30	0.27	0.24
F- test	*	*	*	*	*	*	*	*	*	*	*	*	*	*
S. Em±	0.11	0.13	0.11	0.15	0.12	0.14	0.13	0.16	0.11	0.15	0.12	0.13	0.13	0.14
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 4: Influence of integrated nutrient management on potassium content of alfalfa

Treatment	Potassium content (%)													
	I Harvest		II Harvest		III Harvest		IV Harvest		V Harvest		VI Harvest		VII Harvest	
	Kharif	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*
T_1	0.81	0.80	0.78	0.79	0.77	0.78	0.75	0.76	0.73	0.74	0.72	0.70	0.71	0.69
T_2	0.79	0.77	0.76	0.77	0.75	0.76	0.73	0.74	0.71	0.72	0.70	0.68	0.69	0.66
T_3	0.80	0.79	0.77	0.79	0.76	0.77	0.74	0.75	0.72	0.73	0.71	0.69	0.70	0.68
T_4	0.80	0.78	0.77	0.78	0.76	0.76	0.74	0.75	0.71	0.73	0.71	0.69	0.70	0.67
T_5	0.82	0.81	0.79	0.80	0.79	0.79	0.76	0.78	0.75	0.76	0.73	0.71	0.73	0.70
T_6	0.84	0.83	0.80	0.82	0.80	0.81	0.78	0.79	0.76	0.77	0.75	0.73	0.74	0.71
T_7	0.83	0.82	0.78	0.81	0.79	0.80	0.77	0.78	0.75	0.76	0.74	0.72	0.73	0.70
T_8	0.82	0.80	0.79	0.80	0.78	0.79	0.76	0.77	0.74	0.75	0.73	0.71	0.72	0.69
T_9	0.78	0.76	0.75	0.76	0.74	0.75	0.72	0.73	0.70	0.71	0.69	0.67	0.68	0.65
F- test	--	--	--	--	--	--	--	--	--	--	--	--	--	--
S. Em±	0.10	0.09	0.09	0.11	0.12	0.14	0.13	0.11	0.09	0.11	0.12	0.09	0.12	0.10
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Effect of integrated nutrient management on nutrient uptake in plant

Nitrogen uptake by plant

The data on nitrogen uptake by plant at first and subsequent harvesting of ratoon crops during *kharif* and *rabi* season as influenced by INM are presented in Table 5. The application of 50% RDF+25% N through vermicompost + *Rhizobium* +PSB+VAM has resulted maximum nitrogen uptake by plant at first (34.76 kg ha^{-1}), second (35.57 kg ha^{-1}), third (36.92 kg ha^{-1}), fourth (36.54 kg ha^{-1}), fifth (36.69 kg ha^{-1}), sixth (35.44 kg ha^{-1}) and seventh harvest (34.82 kg ha^{-1}), and cumulative uptake (250.74 kg ha^{-1}) during *kharif* season, which was *at par* with the application of 50% RDF+25% N through poultry manure+*Rhizobium*+PSB+VAM at all the harvests.

The maximum nitrogen uptake by plant was recorded at first (29.98 kg ha^{-1}) second (35.84 kg ha^{-1}), third (36.08 kg ha^{-1}),

fourth (35.44 kg ha^{-1}), fifth (34.67 kg ha^{-1}), sixth (32.48 kg ha^{-1}) and seventh harvest (30.87 kg ha^{-1}), and cumulative uptake (235.36 kg ha^{-1}) during *rabi* season, when plants were supplied with 50% RDF+25% N through vermicompost +*Rhizobium* +PSB+VAM, which was *on par* with the application of 50% RDF+25% N through poultry manure +*Rhizobium*+PSB+VAM at all the harvests. The minimum nitrogen uptake by plant was recorded with the application of 10 t/ha FYM+100% N through FYM in both the season at all the harvest.

Phosphorus uptake of plant

The phosphorus uptake of plant at first and subsequent harvesting of ratoon crops during *kharif* and *rabi* season as effected by INM (Table 6). The application of 50% RDF+25% N through vermicompost+*Rhizobium*+PSB+VAM has resulted maximum phosphorus uptake in plant at first (13.90 kg ha^{-1}), second (13.82 kg ha^{-1}), third (13.92 kg ha^{-1}), fourth (13.49 kg ha^{-1}), fifth (13.22 kg ha^{-1}), sixth (11.48 kg ha^{-1}) and seventh harvest (10.74 kg ha^{-1}), and cumulative uptake (91.47 kg ha^{-1}) during *kharif* season, which was *at par* with the application of 50% RDF+25% N through poultry manure+*Rhizobium*+PSB+VAM at all the harvests.

The maximum phosphorus uptake of plant was recorded at first (12.62 kg ha^{-1}), second (13.73 kg ha^{-1}), third (13.83 kg ha^{-1}), fourth (12.56 kg ha^{-1}), fifth (11.77 kg ha^{-1}), sixth (11.03 kg ha^{-1}) and seventh harvest (8.82 kg ha^{-1}), and cumulative uptake (84.36 kg ha^{-1}) during *rabi* season with 50% RDF+25% N through vermicompost+*Rhizobium*+PSB+VAM, which was *on par* with the application of 50% RDF+25% N through poultry manure+*Rhizobium*+PSB+VAM at all the harvests except at sixth harvest. The application of 10 t/ha FYM+100% N through FYM recorded least phosphorus uptake by plant in both the season at all the harvests.

Potassium uptake by plant

The potassium uptake by plant at first and subsequent harvesting of ratoon crops during *kharif* and *rabi* season as influenced by INM are presented in Table 7. The maximum potassium uptake by plant was recorded at first (25.39 kg ha^{-1}), second (25.41 kg ha^{-1}), third (26.14 kg ha^{-1}), fourth (25.68 kg ha^{-1}), fifth (25.13 kg ha^{-1}), sixth (24.62 kg ha^{-1}) and seventh harvest (24.09 kg ha^{-1}), and cumulative uptake (176.46 kg ha^{-1}) during *kharif* season, when plants were supplied with 50% RDF +25% N through vermicompost +*Rhizobium*+PSB+VAM, which was *on par* with the application of 50% RDF+25% N through poultry manure +*Rhizobium*+PSB+VAM at all the harvests except at second harvest.

The application of 50% RDF +25% N through vermicompost +*Rhizobium*+PSB+VAM has resulted maximum potassium uptake by plant at first (21.83 kg ha^{-1}), second (25.78 kg ha^{-1}), third (25.87 kg ha^{-1}), fourth (25.45 kg ha^{-1}), fifth (24.49 kg ha^{-1}), sixth (22.37 kg ha^{-1}) and seventh harvest (20.87 kg ha^{-1}), and cumulative uptake (166.66 kg ha^{-1}) 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 least potassium uptake by plant was recorded with the application of 10 t/ha FYM+100% N through FYM in both the season at all the harvests.

The increased uptake of N, P and K by the plants could be attributed to the influence of nitrogen fixing bacteria, PSB and VAM applied in combination with organic manures and inorganic fertilizers. Nitrogen fixing bacteria helped not only fixing atmospheric nitrogen and also mobilization of nutrients, which enhanced the availability of nitrogen. The increased availability of phosphorous in the soil due to solubilisations, mobilization and reduces the fixation in soil. The increased uptake of nutrients due to more availability of nutrients resulted in production of maximum biomass. The findings of the present investigation are in agreement with those of the Meharban *et al.* (2013) [11] in ashwagandha, Vishal and Duhan (2013) [21] in kalmegh, Kumar *et al*. (2011) [10] in phyllanthus amarus, Sandya *et al.* (2011) [15] in coleus, Singh (2011) [17] in patchouli, Singh and Ganesh. (2009) [18] in patchouli, Prakasa *et al*. (2007) [14] in french basil, Kavitha and Vadivel (2006) [7] in velvet beans and Suja *et al*. (2005) [20] in cassava.

Table 5: Nitrogen uptake by alfalfa as influenced by integrated nutrient management

Treatment	Nitrogen uptake (kg ha^{-1})															
	I Harvest		II Harvest		III Harvest		IV Harvest		V Harvest		VI Harvest		VII Harvest		Cumulative	
	Kharif	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*
T_1	31.62	27.19	33.10	32.90	33.91	32.95	33.34	32.34	33.58	32.13	32.76	30.18	31.54	28.24	229.85	215.93
T_2	29.74	24.93	31.05	30.85	31.70	30.96	31.98	30.37	32.22	30.04	31.51	28.34	29.78	26.45	217.98	201.94
T_3	31.18	26.15	32.10	31.75	33.25	32.04	32.97	31.44	33.07	31.20	32.50	29.41	31.28	27.59	226.35	209.58
T_4	30.65	25.56	31.89	31.45	32.44	31.35	32.68	30.76	32.51	30.56	31.71	29.09	30.51	27.13	222.39	205.90
T_5	33.42	28.88	34.27	34.48	35.50	35.04	35.24	34.09	35.32	33.65	34.28	31.14	33.25	29.61	241.28	226.89
T_6	34.76	29.98	35.57	35.84	36.92	36.08	36.54	35.44	36.69	34.67	35.44	32.48	34.82	30.87	250.74	235.36
T_7	34.09	29.70	34.94	35.21	36.18	35.56	35.69	34.92	36.05	34.09	34.72	31.94	33.96	30.34	245.63	231.76
T_8	32.37	28.10	33.60	33.71	35.03	34.22	34.56	33.28	34.67	32.89	33.36	27.70	32.50	29.18	236.09	219.08
T_9	29.06	24.87	30.52	29.93	31.05	29.41	30.99	29.13	31.53	28.99	30.83	27.45	28.08	24.33	213.06	194.11
F- test	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
S. Em±	0.34	0.36	0.39	0.38	0.41	0.36	0.38	0.41	0.44	0.35	0.51	0.38	0.48	0.37	0.44	2.85
CD at 5%	1.01	1.05	1.15	1.11	1.21	1.06	1.12	1.20	1.30	1.02	1.50	1.10	1.40	1.08	1.28	8.32

Table 6: Phosphorus uptake by alfalfa as influenced by integrated nutrient management

Treatment	Phosphorus uptake (kg ha^{-1})															
	I Harvest		II Harvest		III Harvest		IV Harvest		V Harvest		VI Harvest		VII Harvest		Cumulative	
	Kharif	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*
T_1	12.36	11.22	13.36	12.26	12.13	12.07	11.84	10.98	11.61	10.30	9.98	9.67	9.27	7.54	80.55	74.04
T_2	11.50	10.21	12.42	11.24	11.06	10.95	10.96	9.93	10.74	9.24	9.18	8.69	8.42	6.74	74.28	67.00
T_3	12.01	10.75	12.90	11.76	11.70	11.55	11.82	10.48	11.23	9.80	9.68	9.22	8.98	7.17	78.32	70.73
T_4	11.92	10.37	12.81	11.64	11.52	12.84	11.40	10.05	10.84	9.40	9.23	8.84	8.54	7.12	76.26	70.26
T_5	13.01	12.01	13.72	13.24	12.79	12.75	12.49	11.68	12.31	10.90	10.89	10.18	9.81	8.33	85.32	79.09

T_6	13.90	12.62	13.82	13.73	13.92	13.83	13.49	12.56	13.22	11.77	11.48	11.03	10.74	8.82	91.47	84.36
T_7	13.46	12.24	13.48	13.39	13.24	13.25	12.98	12.17	12.78	11.36	11.03	10.64	10.25	8.46	88.22	81.51
T_8	12.83	11.64	13.57	12.75	12.74	12.58	12.36	11.51	11.77	10.75	10.38	9.14	9.68	7.93	83.63	76.30
T_9	11.07	9.643	12.03	10.73	10.64	10.46	10.53	9.42	10.30	8.81	8.76	8.23	8.01	6.33	71.34	63.62
F- test	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
S. Em±	0.29	0.17	0.28	0.17	0.31	0.33	0.31	0.29	0.27	0.25	0.17	0.80	0.24	0.14	2.10	1.69
CD at 5%	0.86	0.50	0.81	0.50	0.92	0.96	0.93	0.84	0.78	0.72	0.52	0.27	0.70	0.42	6.10	4.94

Table 7: Potassium uptake by alfalfa as effected by integrated nutrient management

Treatment	Potassium uptake (kg ha^{-1})															
	I Harvest		II Harvest		III Harvest		IV Harvest		V Harvest		VI Harvest		VII Harvest		Cumulative	
	Kharif	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*
T_1	23.29	19.96	23.69	23.63	23.95	23.54	23.37	23.19	22.91	22.44	22.46	20.52	21.96	19.29	161.63	152.57
T_2	22.17	18.29	22.48	22.21	22.43	21.92	22.24	21.62	21.79	20.8	21.42	19.08	20.76	17.81	153.29	141.73
T_3	22.89	19.31	23.1	23.23	23.4	22.82	23.02	22.46	22.46	21.7	22.19	19.9	21.68	18.76	158.74	148.18
T_4	22.7	18.81	22.95	22.71	23.04	22.24	22.81	22.19	21.99	21.45	21.86	19.68	21.36	18.36	156.71	145.44
T_5	24.26	20.70	24.62	24.63	25.27	24.58	24.35	24.62	24.31	23.68	23.39	21.26	23.12	20.13	169.32	159.60
T_6	25.39	21.83	25.41	25.78	26.14	25.87	25.68	25.45	25.13	24.49	24.62	22.37	24.09	20.87	176.46	166.66
T_7	24.83	21.37	24.55	25.24	25.52	25.26	24.99	24.99	24.59	23.99	24.01	21.9	23.39	20.43	171.88	163.18
T_8	23.92	20.26	24.36	24.3	24.84	24.25	24.1	23.95	23.54	23.06	22.98	19.1	22.5	19.55	166.24	154.47
T_9	21.59	17.45	22.01	21.46	21.89	21.22	21.66	20.85	21.22	20.19	20.86	18.39	20.18	17.15	149.41	136.71
F- test	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
S. Em±	0.35	0.36	0.29	0.33	0.27	0.40	0.37	0.24	0.22	0.20	0.40	0.36	0.31	0.41	2.43	2.28
CD at 5%	1.02	1.05	0.85	0.98	0.78	1.17	1.10	0.70	0.65	0.58	1.16	1..05	0.90	1.19	7.10	6.68

Crude protein content of plant

The data on crude protein content of plant at first and subsequent harvesting of ratoon crops during *kharif* & *rabi* season as influenced by INM are presented in Table 8. The application of 50% RDF+25% N through vermicompost +*Rhizobium* +PSB+VAM has resulted maximum crude protein content of plant at first (7.19%), second (7.00%), third (7.16%), fourth (6.94%), fifth (6.94%), sixth (6.75%) and seventh harvest (6.69%) during *kharif* season, which was *at par* with the application of 50% RDF+25% N through poultry manure+*Rhizobium*+PSB+VAM at all the harvests except at third and fourth harvest.

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 *on 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 in both the 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) [3] in berseem.

Experiment II: Effect of integrated nutrient management on nutrient and crude protein content of seeds

NPK and Crude protein content of seeds

The results indicated that, there is no significant difference among treatments with respect to nitrogen, phosphorous, potassium and crude protein content of seeds of alfalfa during *kharif* and *rabi* season.

Table 8: Effect of integrated nutrient management on crude protein content of plant

Treatment	Crude protein content (%)													
	I Harvest		II Harvest		III Harvest		IV Harvest		V Harvest		VI Harvest		VII Harvest	
	Kharif	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*
T_1	6.88	6.81	6.81	6.88	6.81	6.75	6.69	6.63	6.69	6.63	6.56	6.44	6.38	6.31
T_2	6.63	6.56	6.56	6.69	6.63	6.63	6.56	6.5	6.56	6.50	6.44	6.31	6.19	6.13
T_3	6.81	6.69	6.69	6.75	6.75	6.69	6.63	6.56	6.63	6.56	6.50	6.38	6.31	6.25
T_4	6.75	6.63	6.69	6.75	6.69	6.63	6.63	6.50	6.56	6.50	6.44	6.38	6.25	6.19
T_5	7.06	7.06	6.88	7.00	6.94	6.94	6.88	6.75	6.81	6.75	6.69	6.50	6.56	6.44
T_6	7.19	7.14	7.00	7.10	7.16	7.13	6.94	6.88	6.94	6.81	6.75	6.63	6.69	6.56
T_7	7.13	7.13	6.94	7.06	7.00	6.94	6.88	6.81	6.88	6.75	6.69	6.56	6.63	6.50
T_8	6.94	6.94	6.81	6.94	6.88	6.88	6.81	6.69	6.81	6.69	6.63	6.44	6.50	6.44
T_9	6.56	6.50	6.50	6.63	6.56	6.44	6.44	6.38	6.50	6.38	6.38	6.25	6.13	6.00
F- test	*	*	*	*	*	*	*	*	*	*	*	*	*	*
S.Em±	0.03	0.02	0.03	0.04	0.04	0.02	0.01	0.03	0.03	0.02	0.02	0.03	0.04	0.03
CD at 5%	0.10	0.06	0.08	0.12	0.12	0.05	0.04	0.09	0.10	0.05	0.06	0.10	0.11	0.08

Table 9: NPK and Crude protein content in seeds of alfalfa as influenced by integrated nutrient management

Treatment	NPK and Crude protein content of seeds							
	N content (%)		P content (%)		K content (%)		Crude protein (%)	
	Kharif	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*
T_1	3.08	3.10	0.58	0.58	1.39	1.43	19.25	19.38
T_2	3.03	3.05	0.53	0.54	1.36	1.40	18.94	19.06
T_3	3.07	3.08	0.58	0.56	1.37	1.41	19.19	19.25
T_4	3.07	3.08	0.55	0.55	1.37	1.41	19.19	19.25
T_5	3.12	3.16	0.63	0.60	1.42	1.47	19.50	19.75
T_6	3.16	3.20	0.66	0.63	1.45	1.49	19.75	20.00
T_7	3.15	3.19	0.65	0.62	1.44	1.48	19.69	19.94
T_8	3.10	3.13	0.61	0.58	1.41	1.45	19.38	19.56
T_9	3.00	3.02	0.51	0.52	1.35	1.40	18.75	18.88
F- test	--	--	--	--	--	--	--	--
S.Em±	0.45	0.52	0.48	0.51	0.86	0.74	1.82	1.55
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS

Conclusion

The experiment concluded that the effect of integrated nutrient management on nutrient content and uptake in alfalfa under central dry zone of Karnataka revealed that, the application of 50% RDF +25% N through vermicompost +*Rhizobium*+PSB+VAM has recorded maximum nutrient content and uptake in alfalfa during *kharif* and *rabi* season.

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