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Impact of nutrient management practices to soybean-wheat on major nutrient uptake of soybean and wheat in soybean-wheat cropping sequence under rainfed situation in northern transition zone of Karnataka

Kumar CJ, Duragannavar FM, Hosmath JA, Hebsur NS and Basavaraja GT

Abstract
Field experiments were conducted at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad (Karnataka) on vertisol to assess the effect of nutrient management in soybean-wheat sequence cropping under rainfed situation in transition zone of Karnataka during *kharif* and *rabi* seasons of 2019-20 and 2020-21. The experiment was replicated thrice in split plot design. Main plot treatments comprise nutrient management practices to soybean in *kharif* season *viz.,* Absolute control, 100 per cent N + 75 per cent P_2O_5 and K_2O, 100 per cent N, P_2O_5 and K_2O and 100 per cent N + 125 per cent P_2O_5 and K_2O. Sub plot treatments comprise nutrient management practices to wheat in *rabi* season *viz.,* Absolute control, 50 per cent N and P_2O_5, 75 per cent N and P_2O_5 and 100 per cent N and P_2O_5. In *kharif,* significantly higher N, P and K uptake was recorded with application of 100 per cent N + 125 per cent P_2O_5 and K_2O (139.78, 17.55 and 113.26 kg ha^{-1}, respectively) in soybean. In *rabi*, application of 100 per cent N and P_2O_5 to wheat recorded significantly higher N (111.40 kg ha^{-1}), P (30.26kg ha^{-1}) and K uptake (117.70 kg ha^{-1}). Interaction effect of application of 100 per cent N + 125 per cent P_2O_5 and K_2O to soybean followed by 100 per cent N and P_2O_5 to wheat recorded significantly higher N, P and K uptake (116.87, 32.68 and 117.70 kg ha^{-1}, respectively) in soybean found promising with respect to uptake of major nutrients by soybean and wheat in soybean-wheat cropping sequence in transition zone of Karnataka under rainfed situation.

Keywords: Soybean, wheat, cropping sequence nutrient management, nutrient uptake and rainfed

Introduction
Agriculture sector is vital for the food and nutritional security of India (Kadiyala *et al.,* 2014). The sector remains the principal source of livelihood for more than 58 per cent of the population through its contribution (19.90%) to the national gross domestic product (Anon., 2021). Cropping system-based approach to agro-technology development has gained momentum during the past decade after realization of higher productivity. In which selection of crops in sequence is also a key component in the nutrient management strategies. In recent times, soybean-wheat cropping sequence has emerged as a predominant cropping system under rainfed situations. The farmers prefer soybean as a cash crop followed by wheat as a food grain crop (Chandel *et al.,* 2014). The goal of nutrient management in cropping system is to maximize crop productivity with environmental sustainability. The conventional nutrient management is based on the nutrient requirement of individual crops ignoring the carry over effect of organic manures and inorganic fertilizers applied to the preceding crops in *kharif* season. Due to intensive cultivation of crops with unscientific nutrient management practices, the productivity of soil is declining and it is high time for reconsidering the nutrient management practices for individual crops and their interactions in cropping sequence. Further, soybean is a crop which forms root nodules and fix atmospheric nitrogen which would be utilized by the crop in sequence.
Soybean is cultivated as rainy season crop in India on 12.09 million ha, producing 11.22 million tonnes with average productivity of 928 kg ha^{-1}. In Karnataka, it is grown over an area of 0.32 million ha with total production 0.36 million tonnes with average productivity of 1137 kg ha^{-1} (Anon., 2020). In India, wheat is the second most important cereal crop after rice, grown on an area of 31.45 million ha with production of 107.59 million tonnes with productivity of 3421 kg ha^{-1}.

In Karnataka area and production of wheat is 1.67 million ha and 1.79 million tonnes with productivity of 1078 kg ha^{-1} which is less than national average (Anon., 2020). Hence, in order to increase the productivity of soybean and wheat in transitional zone of Karnataka under assured rainfall situation the experiments were planned and executed. As transitional track of Dharwad is blessed with two peaks of rainfall (141.1 mm in June and 101.0 mm in October months). Keeping these points in view the present study was conducted in vertisols of Dharwad under rainfall conditions.

Material and Methods

Field experiments were conducted to study the effect of nutrient management in soybean-wheat sequence cropping system under rainfed situation during *kharif* and *rabi* seasons of 2019-20 and 2020-21 at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad (Karnataka). The geographical co-ordinates of Dharwad are 15 ^{0} 26^1 N latitude and 75 ^{0} 7^1 E longitude with an altitude of 678 m above mean sea level (MSL). Dharwad comes under Northern Transition Zone (Zone-8) of Karnataka which lies between the Western Hilly Zone (Zoe-9) and Northern Dry Zone (Zone-3). The soil of experimental site was black clay (*vertisol*). The texture of soil was clay having organic carbon 0.55 per cent, pH 7.68, EC 0.19 dS m^{-1}, available nitrogen 250.50 kg ha^{-1} (low), available phosphorus 35.40 kg ha^{-1} (medium) and available potassium 320.50 kg ha^{-1} (medium). The experiment was replicated thrice in split plot design. Main plot treatments comprise nutrient management practices to soybean in *kharif* season *viz.*, M_1: Absolute control, M_2: 100 per cent N + 75 per cent P_2O_5 and K_2O, M_3: 100 per cent N, P_2O_5 and K_2O and M_4: 100 per cent N + 125 per cent P_2O_5 and K_2O. Sub plot treatments comprise nutrient management practices to wheat in *rabi* season *viz.*, S_1: Absolute control, S_2: 50 per cent N and P_2O_5, S_3: 75 per cent N and P_2O_5 and S_4: 100 per cent N and P_2O_5.

Soybean crop (cv. DSb-23) was sown at spacing of 30 cm x 15 cm with recommended fertilizer dose of 40: 80: 25 kg N, P_2O_5 and K_2O ha^{-1}. Wheat (cv. UAS-375) was sown at spacing of 22.5 cm row spacing with recommended fertilizer dose of 50: 25: 00 kg N, P_2O_5 and K_2O ha^{-1}.

A known weight of powdered plant samples was treated with concentrated nitric acid and kept overnight for pre digestion. Next day, the pre-digested samples were treated with di acid mixture (HNO_3:$HClO_4$ at 9:4 ratio) and digested on a sand bath at low temperature till colourless white residue was obtained. The residue was dissolved in 6 N HCl and filtered and made to known volume. After digestion, total nitrogen, phosphorus and potash were estimated by Micro Kjeldahl method suggested Tandon (1998) [11]. The following analysis was carried out in the di-acid digest. Nitrogen, phosphorus and potash nutrient uptake (kg ha^{-1}) was worked out using the formula

$$\text{Nutrient uptake (kg ha}^{-1}\text{)} = \frac{\text{Nutrient concentration (\%)} \times \text{Total biomass (kg ha}^{-1}\text{)}}{100}$$

The data was subjected to the statistical analysis (Gomez and Gomez (1984).

Results and discussion

Nitrogen uptake by the soybean (kg ha^{-1})

Application of 100 per cent N + 125 per cent P_2O_5 and K_2O to soybean recorded significantly higher N uptake (139.78 kg ha^{-1}) and found at par with 100 per cent N, P_2O_5 and K_2O (135.87 kg ha^{-1}). Significantly lower N uptake was recorded at absolute control (90.62 kg ha^{-1}). Similar trend was also noticed for individual years. Non significant effect of nutrient management practices to wheat during *rabi* season was noticed on N uptake by the soybean. Similar trend was also noticed for individual years. The N uptake differed significantly with interaction effect of nutrient management practices to soybean and wheat. Application of 100 per cent N + 125 per cent P_2O_5 and K_2O to soybean followed by 100 per cent N and P_2O_5 to wheat recorded significantly higher N uptake (142.07 kg ha^{-1}) (Thakur *et al.* 2009) [12].

Phosphorus uptake by the soybean (kg ha^{-1})

Application of 100 per cent N + 125 per cent P_2O_5 and K_2O (M_4) to soybean recorded significantly higher P uptake (17.55 kg ha^{-1}) and found at par with 100 per cent N, P_2O_5 and K_2O (16.67 kg ha^{-1}). Significantly lower P uptake was recorded at absolute control (10.56 kg ha^{-1}). Similar trend was also noticed for individual years. The effect of nutrient management practices to wheat during *rabi* season was found non significant on phosphorus uptake by the soybean. Similar trend was also noticed for individual years. The P uptake differed significantly with interaction effect of nutrient management practices to soybean in *kharif* and wheat in in *rabi*. Application of 100 per cent N + 125 per cent P_2O_5 and K_2O to soybean followed by 100 per cent N, P_2O_5 and K_2O to wheat recorded significantly higher P uptake (18.53 kg ha^{-1}). The results were in conformity with the findings of Mere *et al.* (2013) [7], who reported that higher nutrient status is due to inclusion of major nutrients in adequate amount through fertilizers and crop residues added by crops involved in sequence cropping systems.

Potassium uptake by the soybean (kg ha^{-1})

Application of 100 per cent N + 125 per cent P_2O_5 and K_2O to soybean recorded significantly higher K uptake (113.26 kg ha^{-1}) and found at par with 100 per cent N, P_2O_5 and K_2O (109.64 kg ha^{-1}). Significantly lower K uptake was recorded at absolute control (87.80 kg ha^{-1}). Similar trend was also noticed for individual years. The effect of nutrient management practices to wheat during *rabi* season was non significant on potassium uptake by the soybean. Similar trend was also noticed for individual years. The K uptake differed significantly with interaction effect of nutrient management practices to soybean and wheat. Application of 100 per cent N + 125 per cent P_2O_5 and K_2O to soybean followed by 100 per cent N and P_2O_5 to wheat recorded significantly higher K uptake (116.67 kg ha^{-1}).

The higher uptake of nutrients was associated with better metabolic activities of plant with concentration and distribution of ions in the external medium. The results were in line with the findings of Kumawat *et al.* (2000) [6] and Surve *et al.* (2019) [10], who indicated that the effects could be attributed to increased nutrient content in soil followed by increased nutrient uptake by plants due to the greater availability of the nutrients. This effect was mainly attributed by increased growth components followed by higher photosynthetic rate and its assimilation in sink as quoted by Paliwal *et al.* (2011) [8].

Nitrogen uptake of wheat (kg ha^{-1})

Application of 100 per cent N + 125 per cent P_2O_5 and K_2O to soybean recorded significantly higher N uptake (106.48 kg ha-

[1]). Significantly lowest N uptake was recorded at absolute control (96.43 kg ha^{-1}). Similar trend was also noticed for individual years. N uptake by the wheat differed significantly with nutrient management practices to wheat during *rabi*. Application of 100 per cent N and P_2O_5 to wheat recorded significantly higher N uptake (111.40 kg ha^{-1}). Significantly lowest N uptake was recorded at absolute control (84.00 kg ha^{-1}) Similar trend was also noticed for individual years The N uptake differed significantly with interaction effect of nutrient management practices to soybean and wheat. Application of 100 per cent N + 125 per cent P_2O_5 and K_2O to soybean followed by 100 per cent N and P_2O_5 to wheat (M_4S_4) recorded significantly higher N uptake (116.87 kg ha^{-1}). Similar results were reported by Anil Kumar *et al.* (2015) [15] and Hanumanth Singh *et al.* (2020) [9]. With respect to nutrient flux of soil media, nutrient level would be balanced between its applications during previous season and get mineralized to succeeding crop uptake. Wheat in this cropping sequence nutritionally benefited with positive impact.

Phosphorus uptake of wheat (kg ha^{-1})

Application of 100 per cent N + 125 per cent P_2O_5 and K_2O to soybean recorded significantly higher P uptake (28.74kg ha^{-1}) compared to absolute control (20.01kg ha^{-1}). Similar trend was also noticed for individual years. P uptake by the wheat differed significantly with nutrient management practices to wheat during *rabi*. Application of 100 per cent N and P_2O_5 to wheat recorded significantly higher P uptake (30.26kg ha^{-1}). Significantly lowest P uptake was recorded at absolute control (16.76kg ha^{-1}). Similar trend was also noticed for individual years.

The P uptake differed significantly with interaction effect of nutrient management practices to soybean and wheat. Application of 100 per cent N + 125 per cent P_2O_5 and K_2O to soybean followed by 100 per cent N and P_2O_5 to wheat recorded significantly higher P uptake (32.68 kg ha^{-1})

Potassium uptake of wheat (kg ha^{-1})

Application of 100 per cent N + 125 per cent P_2O_5 and K_2O to soybean recorded significantly higher K uptake (110.08kg ha^{-1}) compared to absolute control (97.21kg ha^{-1}). Similar trend was also noticed for individual years. Potassium uptake by the wheat differed significantly with nutrient management practices to wheat during *rabi*. Application of 100 per cent N and P_2O_5 to wheat recorded significantly higher K uptake (112.99kg ha^{-1}) compared to absolute control (88.68kg ha^{-1}). Similar trend was also noticed for individual years. The Potassium uptake differed significantly with interaction effect of nutrient management practices to soybean and wheat. Application of 100 per cent N + 125 per cent P_2O_5 and K_2O to soybean followed by 100 per cent N and P_2O_5 to wheat) recorded significantly higher Potassium uptake (117.70 kg ha^{-1}).

Table 1: Major nutrient uptake of soybean in soybean-wheat sequence cropping as influenced by nutrient management practices

Treatment		Major nutrient uptake (kg/ha)								
		Nitrogen			Phosphorus			Potassium		
		2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
Nutrient management practices to soybean (M)										
M_1	Absolute control	90·02^{c}	91·22^{b}	90·62^{c}	9·66^{c}	11·45^{c}	10·56^{c}	87·25^{c}	88·34^{b}	87·80^{c}
M_2	100% N + 75% P_2O_5 and K_2O	122·61^{b}	132·67^{a}	127·64^{b}	13·86^{b}	15·90^{b}	14·88^{b}	102·18^{b}	107·46^{a}	104·82^{b}
M_3	100% N and P_2O_5 and K_2O	129·98^{ab}	141·76^{a}	135·87^{ab}	15·68^{a}	17·66^{a}	16·67^{a}	107·42^{ab}	111·87^{a}	109·64^{ab}
M_4	100% N + 125% P_2O_5 and K_2O	136·28^{a}	143·28^{a}	139·78^{a}	16·68^{a}	18·42^{a}	17·55^{a}	111·36^{a}	115·17^{a}	113·26^{a}
S.Em. ±		3·31	3·01	2·51	0·38	0·39	0·30	1·77	2·21	1·46
Nutrient management practices to wheat (S)										
S_1	Absolute control	115·98^{a}	124·08^{a}	120·03^{a}	13·45^{a}	15·10^{a}	14·28^{a}	99·74^{a}	102·34^{a}	101·04^{a}
S_2	50% N and P_2O_5	118·05^{a}	126·08^{a}	122·07^{a}	13·55^{a}	15·71^{a}	14·63^{a}	100·78^{a}	104·42^{a}	102·60^{a}
S_3	75% N and P_2O_5	122·07^{a}	128·35^{a}	125·21^{a}	14·28^{a}	16·12^{a}	15·20^{a}	103·09^{a}	107·07^{a}	105·08^{a}
S_4	100% N and P_2O_5	122·78^{a}	130·40^{a}	126·59^{a}	14·61^{a}	16·50^{a}	15·56^{a}	104·58^{a}	109·01^{a}	106·80^{a}
S.Em. ±		3·37	2·43	2·47	0·34	0·41	0·32	1·50	2·06	1·26
Interaction (M x S)										
M_1S_1		82·43^{b}	89·13^{c}	85·78^{c}	8·73^{e}	11·07^{d}	9·90^{g}	82·97^{g}	83·80^{c}	83·38^{e}
M_1S_2		88·03^{b}	86·27^{c}	87·15^{c}	9·20^{e}	11·20^{d}	10·20^{g}	84·80^{fg}	85·17^{c}	84·98^{e}
M_1S_3		93·10^{b}	92·90^{c}	93·00^{c}	10·00^{e}	11·57^{d}	10·78^{g}	88·57^{fg}	89·80^{c}	89·18de
M_1S_4		96·50^{b}	96·57^{c}	96·53^{c}	10·71^{e}	11·97^{d}	11·34^{g}	92·67^{ef}	94·60^{bc}	93·63^{d}
M_2S_1		120·73^{a}	129·23^{b}	124·98^{b}	13·57^{cd}	15·47^{c}	14·52^{ef}	100·83^{c-e}	106·53^{ab}	103·68^{c}
M_2S_2		118·73^{a}	132·30^{ab}	125·52^{b}	13·05^{d}	15·67^{c}	14·36^{f}	99·70de	107·13^{ab}	103·42^{c}
M_2S_3		124·93^{a}	133·63^{ab}	129·28^{b}	14·30^{b-d}	16·13^{bc}	15·22^{d-f}	103·90^{b-d}	108·07^{a}	105·98^{bc}
M_2S_4		126·03^{a}	135·50^{ab}	130·77^{b}	14·50^{b-d}	16·33^{bc}	15·42^{c-f}	104·27^{a-d}	108·10^{a}	106·18^{bc}
M_3S_1		126·10^{a}	140·27^{ab}	133·18^{ab}	15·43^{a-c}	17·17^{a-c}	16·30^{b-f}	105·67^{a-d}	110·07^{a}	107·87^{bc}
M_3S_2		129·00^{a}	142·10^{ab}	135·55^{ab}	15·63^{a-c}	17·33^{a-c}	16·48^{a-e}	108·27^{a-d}	110·23^{a}	109·25^{a-c}
M_3S_3		133·47^{a}	142·00^{ab}	137·73^{ab}	15·97^{ab}	17·97^{a-c}	16·97^{a-d}	108·60^{a-d}	112·90^{a}	110·75^{a-c}
M_3S_4		131·33^{a}	142·67^{ab}	137·00^{ab}	15·70^{a-c}	18·17^{a-c}	16·93^{a-d}	107·13^{a-d}	114·27^{a}	110·70^{a-c}
M_4S_1		134·63^{a}	137·70^{ab}	136·17^{ab}	16·07^{ab}	16·70^{bc}	16·38^{a-d}	109·50^{a-d}	108·97^{a}	109·23^{a-c}
M_4S_2		136·43^{a}	143·67^{ab}	140·05^{ab}	16·30^{ab}	18·63^{ab}	17·47^{a-c}	110·37^{a-c}	115·13^{a}	112·75^{ab}
M_4S_3		136·77^{a}	144·87^{ab}	140·82^{ab}	16·83^{a}	18·80^{ab}	17·82^{ab}	111·30^{ab}	117·50^{a}	114·40^{ab}
M_4S_4		137·27^{a}	146·87^{a}	142·07^{a}	17·53^{a}	19·53^{a}	18·53^{a}	114·27^{a}	119·07^{a}	116·67^{a}
S. Em. ±		6·74	4·86	4·94	0·67	0·82	0·63	3·00	4·12	2·51

Means followed by the same letters (s) within a column do not differ significantly by DMRT (P= 0.05)

Soybean: 100% NPK- 40, 80 and 25 kg N, P_2O_5 and K_2O ha^{-1}

M_2, M_3 and M_4 received 6 t ha^{-1}FYM + 12 kg $ZnSO_4$ ha^{-1}+ 20 kg sulphur ha^{-1} as soil application+ 1.25 kg *Rhizobium* + 1.25 kg *PSB* ha^{-1} as seed treatment

Wheat: 100% NP- 50 and 25 kg N and P_2O_5 ha^{-1}

S_2, S_3 and S_4 received 6 t ha^{-1} FYM as soil application

Table 2: Major nutrient uptake of wheat in soybean-wheat sequence cropping as influenced by nutrient management practices

Treatments		Uptake of major nutrients								
		Nitrogen (kg/ha)			Phosphorus (kg/ha)			Potassium (kg/ha)		
		2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
Nutrient management practices to soybean (M)										
M_1	Absolute control	95·42^{c}	97·45^{b}	96·43^{b}	19·69^{b}	20·33^{b}	20·01^{b}	95·83^{c}	98·59^{b}	97·21^{c}
M_2	100% N + 75% P_2O_5 and K_2O	98·65^{bc}	102·87^{ab}	102·76^{ab}	23·08^{ab}	26·68^{a}	24·88^{a}	98·60^{bc}	110·02^{a}	107·31^{a}
M_3	100% N and P_2O_5 and K_2O	102·10^{ab}	105·01^{a}	103·55^{ab}	25·37^{a}	28·38^{a}	26·88^{a}	102·01^{ab}	110·20^{a}	108·10^{a}
M_4	100% N + 125% P_2O_5 and K_2O	104·06^{a}	108·89^{a}	106·48^{a}	27·02^{a}	30·46^{a}	28·74^{a}	104·42^{a}	115·73^{a}	110·08^{a}
S. Em.±		1·38	2·05	1·46	1·21	1·67	1·32	1·55	2·79	0·95
Nutrient management practices to wheat (S)										
S_1	Absolute control	83·89^{c}	84·10^{b}	84·00^{c}	16·26^{c}	17·26^{c}	16·76^{c}	86·65^{c}	90·72^{c}	88·68^{c}
S_2	50% N and P_2O_5	100·13^{b}	107·11^{a}	103·62^{b}	22·98^{b}	27·27^{b}	25·12^{b}	99·56^{b}	111·53^{b}	105·55^{b}
S_3	75% N and P_2O_5	105·98^{a}	110·45^{a}	108·21^{a}	26·84^{ab}	29·89^{ab}	28·37^{a}	106·29^{a}	114·67^{a}	110·48^{a}
S_4	100% N and P_2O_5	110·23^{a}	112·56^{a}	111·40^{a}	29·08^{a}	31·44^{a}	30·26^{a}	108·36^{a}	117·63^{a}	112·99^{a}
S. Em.±		1·60	2·08	1·37	1·66	1·32	1·00	1·66	2·45	1·28
Interaction (M x S)										
M_1S_1		76·20^{i}	77·13^{c}	76·67^{f}	7·27^{c}	7·77^{e}	7·52^{f}	73·67^{f}	75·53^{g}	74·60^{h}
M_1S_2		96·70^{d-f}	102·77^{b}	99·73^{d}	21·33^{ab}	22·40^{cd}	21·87^{c-e}	98·40^{b-d}	102·37^{c-e}	100·38^{ef}
M_1S_3		99·53^{c-e}	103·73^{b}	101·63^{cd}	22·03^{ab}	23·53^{b-d}	22·78^{c-e}	104·23^{a-c}	104·37^{b-f}	104·30^{c-f}
M_1S_4		109·23^{a-c}	106·17^{ab}	107·70^{b-d}	28·13^{a}	27·63^{a-d}	27·88^{a-c}	107·03^{ab}	112·10^{a-e}	109·57^{a-d}
M_2S_1		83·63^{hi}	87·27^{c}	85·45^{e}	14·87^{bc}	19·63^{d}	17·25^{e}	85·90^{e}	97·57^{ef}	91·73^{g}
M_2S_2		95·37^{e-g}	106·13^{ab}	100·75^{cd}	21·13^{ab}	26·63^{a-d}	23·88^{b-d}	95·67^{c-e}	111·67^{a-e}	103·67^{d-f}
M_2S_3		105·53^{a-e}	108·80^{ab}	107·17^{b-d}	26·67^{a}	29·97^{a-c}	28·32^{a-c}	105·23^{a-c}	114·30^{a-d}	109·77^{a-d}
M_2S_4		110·07^{a-c}	109·27^{ab}	109·67^{a-c}	29·63^{a}	30·50^{a-c}	30·07^{ab}	107·60^{ab}	116·53^{a-d}	112·07^{a-d}
M_3S_1		89·37^{f-h}	83·43^{c}	86·40^{e}	21·77^{ab}	19·23^{d}	20·50de	95·17^{c-e}	88·57^{fg}	91·87^{g}
M_3S_2		103·67^{b-e}	107·70^{ab}	105·68^{b-d}	24·10^{ab}	28·73^{a-c}	26·42^{a-d}	101·37^{b-d}	113·70^{a-e}	107·53^{b-e}
M_3S_3		108·37^{a-c}	113·20^{ab}	110·78^{ab}	27·97^{a}	32·40^{a}	30·18^{ab}	106·30^{a-c}	118·47^{a-c}	112·38^{a-c}
M_3S_4		107·00^{a-d}	115·70^{ab}	111·35^{ab}	27·63^{a}	33·17^{a}	30·40^{ab}	105·20^{a-c}	120·07^{ab}	112·63^{a-c}
M_4S_1		86·37^{gh}	88·57^{c}	87·47^{e}	21·13^{ab}	22·40^{cd}	21·77^{c-e}	91·87de	101·20^{d-f}	96·53^{fg}
M_4S_2		104·77^{a-e}	111·83^{ab}	108·30^{a-d}	25·33^{ab}	31·30^{ab}	28·32^{a-c}	102·80^{a-c}	118·40^{a-c}	110·60^{a-d}
M_4S_3		110·47^{ab}	116·07^{ab}	113·27^{ab}	30·70^{a}	33·67^{a}	32·18^{a}	109·40^{ab}	121·53^{a}	115·47^{ab}
M_4S_4		114·63^{a}	119·10^{a}	116·87^{a}	30·90^{a}	34·47^{a}	32·68^{a}	113·60^{a}	121·80^{a}	117·70^{a}
S. Em.±		3·19	4·17	2·75	3·32	2·64	1·99	3·31	4·90	2·57

Means followed by the same letters (s) within a column do not differ significantly by DMRT (P= 0.05)

Soybean: 100% NPK- 40, 80 and 25 kg N, P_2O_5 and K_2O ha^{-1}

M_2, M_3 and M_4 received 6 t ha^{-1}FYM + 12 kg $ZnSO_4$ ha^{-1}+ 20 kg sulphur ha^{-1} as soil application+ 1.25 kg *Rhizobium* + 1.25 kg *PSB* ha^{-1} as seed treatment

Wheat: 100% NP- 50 and 25 kg N and P_2O_5 ha^{-1}

S_2, S_3 and S_4 received 6 t ha^{-1} FYM as soil application

DAS- Days after sowing

Conclusion

Significantly higher major nutrient uptake was recorded in soybean with application of 100 per cent N + 125 per cent P_2O_5 and K_2O in *kharif* soybean,. In *rabi* application of 100 per cent N and P_2O_5 to wheat recorded significantly higher major nutrient uptake. Interaction effect was noticed with application of 100 per cent N + 125 per cent P_2O_5 and K_2O to soybean followed by 100 per cent N, and P_2O_5 to wheat found promising with respect to uptake of major nutrients by soybean and in soybean-wheat cropping sequence in Northern Transition of Karnataka under rainfed situation.

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