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Research Article

EFFECT OF INTEGRATED NUTRIENT MANAGEMENT MODULES ON NUTRIENT UPTAKE, QUALITY AND ECONOMICS OF HIGH YIELDING VARIETIES OF CHICKPEA (*CICER ARIETINUM* L.) UNDER LATE SOWN CONDITION

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Abstract: The present investigation was conducted with the objective to know the Effect of integrated nutrient management modules on nutrient uptake, quality and economics of high yielding varieties of chickpea (*Cicer arietinum* L.) under late sown condition. The study comprised four treatments of nutrient management modules (a) F_0 – Control, (b) F_1-RDF(20 kg N, 50 kg P_2O_5 ha^{-1}) + RC (*Rhizobium culture*), (c) F_2 - RDF + PSB (Phosphorus solubilizing bacteria),(d) F_3 - RDF + RC +PSB and three varieties namely Uday , Avrodhi and PUSA-362. The study revealed that the nutrient management modules F_3 – RDF (20 kg N, 50 kg P_2O_5 ha^{-1}) + RC +PSB found suitable for maximum nutrient uptake and quality of chickpea with variety PUSA-362. The maximum nutrient (NP) uptake found with PUSA-362 which was significantly superior over Uday, It remained at par with Avrodhi. Nitrogen content in grain and straw of different varieties were recorded non-significant. Varieties of chickpea did not differ significantly in the protein content. The highest net return of Rs 34740 ha^{-1} was recorded with PUSA-362 with RDF + RC + PSB, against lowest net return of Rs. 7343 ha^{-1} recorded with unfertilized Uday variety. Maximum gross return, net return and benefit cost ratio were calculated with the application of F_3 – RDF (20 kg N, 50 kg P_2O_5 ha^{-1}) + RC +PSB and variety PUSA-362. Thus it may be concluded that PUSA-362 fertilized with F_3 – RDF (20 kg N, 50 kg P_2O_5 ha^{-1}) + RC +PSB may be found highest economic value of chickpea in eastern Uttar Pradesh conditions.

Keywords: INM, Nutrient uptake, Quality, Economics

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Introduction

Chickpea (*Cicer arietinum* L.) is also called as gram or bengalgram. It is most important pulsecrop in India. In India, chickpea has about 38 per cent of total area and 50 per cent of total production of pulse. Chickpea seed contains 23% protein, 64% total carbohydrates, 47% starch, 5% fat, 6% crude fiber, 6% soluble sugar and 3% ash. The mineral component is high in phosphorus (340 mg 100^{-1} g), calcium (190 mg 100^{-1} g), magnesium (140 mg 100^{-1} g), iron (7 mg 100^{-1} g) and zinc (3 mg 100^{-1} g). The lipid fraction is high in unsaturated fatty acids, primarily linoleic and oleic acids. During 2010, the global chickpea production was 8.58 million tonnes from an area of 11.15 million ha, giving an average productivity of 769.4 kg ha^{-1}. In India, pulses occupy 23.76 million ha area contributing 14.11 million tones and average productivity of 625 kg ha^{-1} to the world food basket [1]. The integrated nutrient management, increasing nutrient-use efficiency, would lower the cost of production. The integrated nutrient management will also help in maintaining soil health and productivity [2]. The conjunctive use of chemical, organic and bio-fertilizers enhance the yield of chickpea considerably. The choice of integrated nutrient management modules depends on the available technology, planting methods, cropping system and farmers resources. No single method will give continuous and effective nutrient supply in all situations as crop varies in their growth habits. Study of the effect of various integrated nutrient management modules on yield of chickpea will be of immense significance to understand the requirement of inorganic fertilizer alone or in combination with organic manure may be instrumental to enhance the yield of chickpea, because they reach their full yield potential with adequate supply of all the essential nutrients.

Keeping this idea in view, four integrated nutrient management modules were undertaken to find out the best suitable integrated nutrient management module, intended for economical production of chickpea under late sown condition. High demands for food due to rapidly increasing population and changes in dietary habits are increasing pressure on agriculture, to meet the food requirement of these increased population. Productivity and quality of chickpea crop can be possible by adopting better agronomic practices and replacing conventional varieties with high yielding improved varieties, which have to potential to fit in the current cropping system, particular location and soil types. Adoption of high yielding variety of chickpea under late sown condition is one of the important input, which may hold promise to improve the plant ability of the crop, ultimately caused, increased grain production. Hence, the application of inorganic fertilizers and organic manures in proper proportion with suitable high yielding variety is necessary to augment the productivity of chickpea under late sown condition. Keeping this idea in view, three popular and improved varieties of chickpea are under taken to study the best suitable in eastern Uttar Pradesh intended for economical production.

Materials and Methods

The experiment was conducted at Agronomy Research Farm Narendra Deva University of Agriculture and Technology Kumarganj, Faizabad, U.P. in *Rabi* season of 2011-12. Geographically the experimental site is situated at 26.470 North latitude and 82.120 East longitude with is an elevation of about 113 m. from mean sea level in the Indo Gangatic Plain Zone of eastern Uttar Pradesh.

This, region receives an average annual rainfall of about 1280 mm. The rainfall is erratically distributed. Major rains are received from mid-June to end of September. Summer is hot and dry. Westerly hot winds start from the month of March and continue up to onset of monsoon. Winter months are cold and occasional frost occurs during this period. And during the crop season, the maximum temperature varied from 15.3 to 37.5°C. Total rainfall received during the crop period was 86 mm. Relative humidity was the maximum in the month of February during the crop period. The sunshine ranged from 0.5-8.6 hours. The soil is sandy to sandy loam with a pH of 5.05 and 0.72% organic C. Soil low in available N (127.92 kg ha^{-1}), medium in available P (21.59 kg ha^{-1}) and low in available K (122.46 kg ha^{-1}). The treatment was carried out with 12 treatment combination formed with six nutrient management levels and three varieties in rice which were allocated in RBD with three replications. The four nutrient management modules (a) F_0 – Control, (b) F_1- RDF(20 kg N, 50 KG P_2O_5 ha^{-1}) + RC (Rhizobium culture), (c) F_2 - RDF + PSB (Phosphorus solbulizing bacteria), (d) F_3 - RDF + RC +PSB and three varieties namely Uday , Avrodhi and PUSA-362. The crop sowing was done @ 100Kg seed ha^{-1}. Chickpea variety Uday, Avrodhi and PUSA-362 was sown at the rate of 100 kg ha^{-1} on 06.12.2011. The seeds were sown by hand hoe at the depth of 6-8cm. The distance between two rows was maintained 30 cm. Irrigations were scheduled on the basis of critical stages *i.e.* branching stage, pod formation stage.

NP uptake (kg ha^{-1})

The plant samples taken at harvest were first sun dried and then oven dried at 600C for 24 hours. The straw and grain samples were ground separately as to pass 20 mesh for chemical analysis.

Quality studies

Nitrogen content (%) in straw and grain

Nitrogen content at harvest stage was determined by modified micro-Kjeldahl's method (Jackson, 1973) in seed and stover, separately.

Protein content (%)

Protein content in grain was calculated by multiplying nitrogen content in grain with the factor of 6.25. Micro-Kjeldahl's method was followed for determination of nitrogen content in grain.

Economics

Cost of cultivation (Rs ha^{-1})

Cost of cultivation for different treatments were worked out by considering all the expenses incurred in the cultivation of experimental crop and added with variable cost due to treatments.

Gross return (Rs ha^{-1})

Gross return was worked out by multiplying grain and straw yield separately under various treatments to their existing market price. The money value of both grain and straw yield was added together in order to achieve gross return Rs ha^{-1}.

Net return (Rs ha^{-1})

Net return was calculated by deducting the cost of cultivation from the gross return of the individual treatments.

Benefit cost ratio

Benefit cost ratio was worked out by dividing the net return to the cost of cultivation of individual treatments.

$$\text{Net return Rs}^{-1}\text{ invested} = \frac{\text{Net return (Rs. ha}^{-1})}{\text{Total cost of cultivation (Rs.ha}^{-1})}$$

Results and Discussion

Nutrient Uptake (kg ha^{-1}) / Nitrogen uptake by grain

Nitrogen uptake by chickpea as influenced by integrated nutrient management modules and varieties have been presented in [Table-1]. The nitrogen uptake by grain was significantly influenced by various integrated nutrient management modules recorded highest uptake of 53.29 kg N ha^{-1} with RDF + RC + PSB ,which was significantly superior over control and RDF + RC but found at par with RDF + PSB. The different varieties also influenced the nitrogen uptake by grain significantly. The maximum nitrogen uptake of 47.85 kg ha^{-1} was recorded by PUSA-362, which was significantly superior over Uday but remained at par with Avrodhi.

Table-1 *Effect of integrated nutrient management modules and variety on nitrogen uptake (kg ha^{-1}) by chickpea*

Treatment	N uptake by grain (kg ha^{-1})	N uptake by straw (kg ha^{-1})	N uptake by crop (kg ha^{-1})
Variety			
V_1	36.80	6.63	43.43
V_2	46.75	8.25	55.00
V_3	47.85	8.37	56.22
SEm±	1.02	0.12	1.06
CD at 5%	2.99	0.35	3.13
Fertilizers			
F_0	25.11	5.09	30.20
F_1	44.96	7.93	52.89.
F_2	51.85	8.97	60.81
F_3	53.29	9.02	62.31
SEm±	1.17	0.13	1.23
CD at 5%	3.45	0.40	3.61

Table-2 *Effect of integrated nutrient management modules and variety on P uptake (kg ha^{-1}) by chickpea*

Treatment	P uptake by seed (kg ha^{-1})	P uptake by straw (kg ha^{-1})	P uptake by crop (kg ha^{-1})
Variety			
V_1	3.26	.51	4.77
V_2	4.11	1.87	5.98
V_3	4.20	1.90	6.11
SEm±	0.07	0.02	0.09
CD at 5%	0.23	0.08	0.26
Fertilizers			
F_0	2.48	1.14	3.62
F_1	3.96	1.80	5.76
F_2	4.47	2.04	6.52
F_3	4.52	2.06	6.58
SEm±	0.09	0.03	0.10
CD at 5%	0.26	0.09	0.30

N uptake by straw (kg ha^{-1})

The result embodied in [Table-1] manifested significant effect due to integrated nutrient management modules on RDF + RC+ PSB showed their superiority over control and RDF + RC but equal with RDF + PSB. Overall the INM modules promoted nitrogen uptake by straw. Significant effect due to different variety enhanced the uptake of nitrogen in straw 6.63, 8.25 and 8.37 by Uday, Avrodhi and PUSA-362, respectively. The trend of variation followed the N-uptake of grain.

Nitrogen uptake by crop kg ha^{-1}. Nitrogen uptake by chickpea crop as influenced by integrated nutrient management modules and different varieties have been presented in [Table-1]. Significant increase in nitrogen uptake was observed with the application of RDF + RC+ PSB in which nitrogen uptake was improved significantly over RDF + RC and control. The enhanced N uptake may be due to adequate availability of this nutrient in soil which increases the N absorption by the plants ultimately increased the N uptake by seed and straw and total biological yield also affected the N uptake. These findings are in accordance with the results obtained by Asewar *et al.* (2003), Jat and Ahlawat (2004) and Deshmukh *et al* (2010).

Phosphorus uptake (kg ha^{-1})

Data also showed that phosphorus uptake increased with RDF when associated with Rhizobium, PSB. Maximum phosphorus uptake was recorded with RDF + RC + PSB which was significantly superior over control and RDF + RC. This may be due to availability of phosphorus increased it content in plants and total biological yield, which increased the phosphorus uptake. These results are in agreement with the findings of Puste et al. (2001), Singh *et al.* (2003), Asewar *et al.* (2003), Jat and Ahlawat (2004) and Deshmukh *et al.* (2010).

Nitrogen content

It is obvious from the data that nitrogen content of chickpea was affected by various nutrient management modules.

Table-3 *Effect of integrated nutrient management modules and variety on grain and straw by chickpea*

Treatment	N content in grain (%)	N content in straw (%)
Variety		
V_1	3.55	0.54
V_2	3.62	0.55
V_3	3.63	0.55
SEm±	0.02	0.00
CD at 5%	NS	NS
Fertilizers		
F_0	3.15	0.53
F_1	3.66	0.54
F_2	3.76	0.55
F_3	3.82	0.55
SEm±	0.03	0.00
CD at 5%	0.09	NS

Table-4 *Effect of integrated nutrient management modules and variety on protein content (%) in chickpea*

Treatment	Protein content (%)
Variety	
V_1	22.21
V_2	22.60
V_3	22.70
SEm±	0.22
CD at 5%	NS
Fertilizers	
F_0	19.71
F_1	22.90
F_2	23.50
F_3	23.89
SEm±	0.26
CD at 5%	0.760

Table-5 *Effect of various treatment influence the economics*

Treatment combinations	Common cost (Rs ha^{-1})	Total cost (Rs ha^{-1})	Gross return (Rs ha^{-1})	Net return (Rs ha^{-1})	B:C
V_1F_0	14257	19657	27000	7343	0.37
V_1F_1	14257	22660	41800	19140	0.84
V_1F_2	14257	22750	47000	24250	1.06
V_1F_3	14257	22840	47520	24680	1.08
V_2F_0	14257	19757	29610	9856	0.49
V_2F_1	14257	22760	45500	22740	0.99
V_2F_2	14257	22850	51450	28600	1.25
V_2F_3	14257	22940	51800	28860	1.25
V_3F_0	14257	19457	32870	13413	0.68
$V3_1F_1$	14257	22460	50540	28080	1.25
V_3F_2	14257	22550	56620	34070	1.51
V_3F_3	14257	22640	57380	34740	1.53

The maximum N content in grain with treatment consisting RDF + RC+PSB may be because of higher N utilization by the crop. Which enhanced the nitrogen content synthesis in plants and ultimately increased the nitrogen content in chickpea seed by increasing the osmophyllic bodies and formation of amino acid. Further it is notices that nitrogen in seed increased in the treatment consisting rhizobium, PSB when applied in combination with RDF. The maximum nitrogen content was observed in the treatment consisting RDF + RC +PSB because of more nitrogen utilization by the crop which ultimately enhanced the nitrogen content in grain and straw. The results are in accordance with those of Bermner *et al*. (1996), Rajani and Rakholiya (2010).

Protein content

The data pertaining to protein content of chickpea are presented in [Table-4]. It is obvious from the data that protein content of chickpea was affected by various nutrient management modules. The maximum protein content in grain with treatment consisting RDF + RC+PSB may be because of higher N utilization by the crop. The maximum N content was observed in the treatment with RDF + RC +PSB because of more nitrogen utilization by the crop which ultimately enhanced the N content in grain. The result are in close conformity with the findings of Puste *et al*. (2001), Singh *et al* (2003), Asewar *et al*. (2003), Jat and Ahlawat (2004) and Deshmukh *et al* (2010).

Economics

The cost of cultivation, net return and B:C ratio varied with different treatment [Table-5] mainly due to differences in the cost of fertilizers under various treatment combinations. The maximum net income of Rs 34740 ha^{-1} was found with RDF + RC +PSB while the minimum net income of chickpea was recorded from unfertilized Uday variety. Benefit cost ratio of 1.53 was recorded with RDF+ RC+PSB followed by PUSA-362, against minimum benefit cost ratio of 0.37 found in unfertilized Uday variety of chickpea. The benefit cost ratio decreased at higher fertility levels due to increase in cost of cultivation with nominal increase in net return. The increase in net return and benefit; cost ratio with this treatment might be due to higher additional return by chickpea crop. Similar findings were also reported by Puste *et al*. (2001), Asewar *et al*. (2003).

Application of research: The study revealed that the nutrient management modules F_3 - RDF (20 kg N, 50 kg P_2O_5 ha^{-1}) + RC +PSB found suitable for maximum nutrient uptake and quality of chickpea with variety PUSA-362

Research Category: Extension Education

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