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Effect of nutrient management on yield attributes and yield of chickpea (*Cicer arietinum*)

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Abstract
A field experiment entitled "Effect of nutrient management on yield attributes and yield of chickpea" was conducted at the experimental field of Pandit Deen Dayal Upadhyay Institute of Agricultural Sciences located at Utlou, Bishnupur district, Manipur during *rabi* season 2019-2020 to study the performance of chickpea (JG-14) under different management of nutrient. The soil of the experimental site was clayey, strongly acidic (pH 5.2), high in organic carbon (1.04%), medium in available nitrogen (296.81 kg ha^{-1}), medium in available P_2O_5 (46.47 kg ha^{-1}) and medium in available K_2O (254.00 kg ha^{-1}). The experiment was laid out in Randomized block design consisting of seven treatments i.e. T_1: NPK @ 20:40:20, T_2: NPKS @ 20:40:20:20, T_3: NPK@ 20:40:20 + 0.5% Zn foliar application, T_4: NPKS @ 20:40:20:20 (50%) + 0.5% Zn foliar application, T_5: NPKS @ 20:40:20:20 (75%) + 0.5% Zn foliar application, T_6: NPKS @ 20:40:20:20 (100%) + 0.5% Zn foliar application, T_7: NPKS @ 20:40:20:20 (125%) + 0.5% Zn foliar application with three replications. Considering the overall economics of the treatments, the net returns and benefit cost ratio were found to be higher with treatment T_7: NPKS @ 20:40:20:20 (125%) + 0.5% Zn foliar application. The experimental results revealed that application of NPKS @ 20:40:20:20 (125%) + 0.5% Zn foliar application was found to be ideal for chickpea for high yield and assured income in *rainfed* condition.

Keywords: Nutrient management, growth, yield and chickpea

Introduction
Chickpeais occupying a unique position in agriculture by virtue of the fact that they constitute a major and the only high protein component to the average Indian diet. Chickpea is currently growing at an area about 10.7 m ha worldwide with an average production of 12 million tons per year. Nutrient management is an important factor for production of chickpea. The area under chickpea is increasing but the yield performance is decreasing. The reason may be due to decreasing oil fertility especially macro and micro nutrient, imbalance use of fertilizers, lack of nutrients during critical stages of crop growth which leads to nutrient stress, poor growth and productivity of the chickpea. Although, chickpea still grow on low fertility soil, the yield quality and quantity has been impacted which can be improved by giving the plant the proper nutrition especially through an optimum nutrient combination. The potential of chickpea has not explored much in Manipur. Hence, the present investigation was carried out to find out appropriate nutrient management to give better productivity and economic returns in chickpea.

Materials and Method
A field experiment entitled " Effect of nutrient management on yield attributes and yield of chickpea" was conducted at the experimental field of Pandit Deen Dayal Upadhyay Institute of Agricultural Sciences located at Utlou, Bishnupur district, Manipur during *rabi* season 2019-2020 to study the performance of chickpea (JG-14) under different fertilizer levels The soil of the experimental site was clayey, strongly acidic (pH 5.2), high in organic carbon (1.04%), medium in available nitrogen (296.81 kg ha^{-1}), medium in available P_2O_5 (46.47 kg ha^{-1}) and medium in available K_2O (254.00 kg ha^{-1}).The experiment was laid out in Randomized block design consisting of seven levels of fertilizers i.e. T_1: NPK @ 20:40:20, T_2: NPKS @ 20:40:20:20, T_3: NPK 20:40:20 + 0.5% Zn foliar application, T_4:NPKS @ 20:40:20:20 (50%) + 0.5% Zn foliar application, T_5: NPKS @ 20:40:20:20 (75%) + 0.5% Zn foliar application, T_6: NPKS @ 20:40:20:20 (100%) + 0.5% Zn foliar application, T_7: NPKS @ 20:40:20:20 (125%) + 0.5% Zn foliar application with three replications. The chickpea variety JG-14 was sown in line with 30 x 10cm and seed rate of 60 kgha^{-1}.

The statistical differences of the data were tested using analysis of variance technique (ANOVA). The standard error of means (S.Em±) and critical difference (CD) at 5% level of significance were calculated to compare the treatment means.

Results and Discussion

Yield and Yield attributes of chickpea

Data regarding the effect of nutrient management on yield and yield attributes are shown in Table 1 and the value increased as higher dose of NPK are applied in the soil and also sulphur increased the rate of photosynthesis while Zinc helps to utilize physiological and morphological properties of plants such as nitrogen metabolism as well as helps in increasing chlorophyll synthesis (Potarzycki and Grzebisz, 2009) [13]. Application of NPKS @ 20:40:20:20 (125%) + 0.5% Zn foliar application (Table 1) gives the highest number of pods per plant (47.80), number of seeds per pod (1.80), seed yield (561.21 kg ha^{-1}) which is 60.20% from control, stover yield (1152.90 kg ha^{-1}), harvest index (30.63%) in chickpea.

The lowest number of pods (43.60), number of seeds per pod (1.00), seed yield (350.30 kg ha^{-1}), stover yield (883.05 kg ha^{-1}) and harvest index (26.49%) was recorded from control.

Economics

The economic return of crop cultivation is an important factor as it indicates its benefit while implementing a specific treatment. The highest cultivation cost was obtained from T_7 due to higher fertilizers needed in this treatment and the lowest was obtained from T_1 (Table 2). Although, application of NPKSZn @ 20:40:20:20 (125%) + 0.5% Zn foliar application had a higher cost of cultivation, the highest gross return (₹44,896ha^{-1}), net return (₹7,184 ha^{-1}) and B: C ratio (1.19) was obtained with this treatment. This might be due to the higher seed yield obtained, resulting in a higher net return than other treatments. The lowest return was obtained from control with a gross return of ₹28,024 ha^{-1}, a net return of ₹1,471 ha^{-1} and B: C ratio of 1.01.

Table 1: Effect of Nutrient Management on number of pods/plant, seeds/pod & test weight (g) of chickpea

Treatments	Yield and yield attributes					
	Number of pods/plant	Number of seeds/pod	Test weight (g)	Seed yield (kg ha^{-1})	Straw yield (kg ha^{-1})	HI (%)
Fertilizers						
T_1	43.60	1.00	20.23	350.30	883.05	26.49
T_2	45.60	1.53	20.43	450.50	1065.75	27.75
T_3	44.67	1.46	20.30	416.16	1054.20	26.39
T_4	43.87	1.06	21.17	370.88	936.60	26.47
T_5	45.86	1.56	20.23	456.27	1083.60	27.65
T_6	47.06	1.73	21.80	509.21	1127.70	29.10
T_7	47.80	1.80	20.96	561.21	1152.90	30.63
S.Em ±	0.15	0.05	NS	11.55	15.81	0.66
CD (P =0.05)	0.49	0.16	NS	35.61	2.62	2.04

T_1: NPK@ 20:40:20, T_2: NPKS @ 20:40:20:20, T_3: NPKZn @ 20:40:20 + 0.5% Zn foliar application, T_4: NPKSZn @ 20:40:20:20 (50%) + 0.5% Zn foliar application, T_5: NPKSZn @ 20:40:20:20 (75%) + 0.5% Zn foliar application, T_6: NPKSZn @ 20:40:20:20 (100%) + 0.5% Zn foliar application, T_7: NPKSZn @ 20:40:20:20 (125%) + 0.5% Zn foliar application

Table 2: Effect of Nutrient Management on the economics of chickpea

Treatments		Economics		
	Cultivation cost (₹/ha)	Gross Return (₹/ha)	Net return (₹/ha)	B: C ratio
Fertilizers				
T_1	26,553	28,024	1,471	1.01
T_2	32,629	36,040	3,411	1.06
T_3	28,293	33,292	5,000	1.17
T_4	27,679	29,664	1,985	1.07
T_5	31,024	36,501	5,478	1.17
T_6	34,369	40,739	6,368	1.18
T_7	37,713	44,896	7,184	1.19

T_1: NPK@ 20:40:20, T_2: NPKS @ 20:40:20:20, T_3: NPKZn @ 20:40:20 + 0.5% Zn foliar application, T_4: NPKSZn @ 20:40:20:20 (50%) + 0.5% Zn foliar application, T_5: NPKSZn @ 20:40:20:20 (75%) + 0.5% Zn foliar application, T_6: NPKSZn @ 20:40:20:20 (100%) + 0.5% Zn foliar application, T_7: NPKSZn @ 20:40:20:20 (125%) + 0.5% Zn foliar application

Conclusion

Thus, from the present investigation, it can be concluded that increasing levels of nutrients with 125% of the recommended NPKS (20:40:20:20 kg ha $^{-1}$) along with the foliar application of Zinc (0.5%) at the flowering stage proved to be more productive and profitable in rainfed chickpea cultivation of Manipur during *rabi* season.

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