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Effect of foliar application of fertilizers on yield attributes, yield and economics of chickpea (*Cicer arietinum* L.)

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Abstract
A field experiment was conducted at experimental farm of Cotton Research Scheme, VNMKV Parbhani, during year 2020-21. The experiment was laid out in Randomized block design with eight treatments and three replications. Foliar application of fertilizers (1%) done at flowering and pod development. The treatments were allotted randomly in each replication. The recommended cultural practices and plant protection measures were properly taken time to time. The recommended dose of fertilizer (25:50:25 NPK kg ha^{-1}) was applied at the time of sowing through Urea, SSP and MOP. An investigation showed that the maximum growth attributes *viz.* plant height (cm), mean number of branches plant^{-1}, mean number of leaves plant^{-1}, mean leaf area (dm^2) plant^{-1} and mean dry matter plant-^{1} (g) was recorded by treatment T_4 i.e., RDF + 1% 19:19:19 NPK spraying at flowering and pod development stage. The mean number of nodule plant^{-1} was not influenced significantly by various foliar application of fertilizers in chickpea. Maximum mean absolute growth rate (AGR) for height (cm), mean absolute growth rate for (AGR) dry matter (g day^{-1}), mean relative growth rate (RGR) for dry matter (g g^{-1}day^{-1}), mean net assimilation rate (NAR) for dry matter (g $^{-1}$ dm^{-2} day^{-1}) and leaf area index recorded with T_4 i.e., RDF + 1% 19:19:19 NPK spraying at flowering and pod development stage. However, treatment T_8 - Control (No RDF, No spray) were recorded minimum values for growth attributes.

Keywords: Chickpea, fertilizers, foliar application, 19:19:19 NPK, 00:52:34 NPK, 13:40:13 NPK

Introduction
Chickpea (*Cicer arietinum* L.) popularly known as Gram or Bengal gram is most important and premier pulse crop of India. In 2017-18, chickpea was cultivated in about 106 Lha. The country harvested a record production of more than 111 Lakh tones at the ever-highest productivity level of 1056 kg ha^{-1} Anonymous. (2018) [3]. Chickpea is an important source of protein in diet and particularly important in vegetarian diet, also it is being used increasingly as a helpful source of zinc and foliate. In India, chickpea cultivation is being restricted mainly to rainfed areas or under residual moisture, lack of nutrient management, low harvest index and poor management of pest and diseases are main reason to low productivity. Foliar application of water-soluble fertilizers has good effect on growth, yield, and quality of crops (Patel and Patel, 1994) [8]. Application of nutrients through foliar spray along with soil application has several advantages in supplementing the nutritional requirement of crops. Retention of flower is possible through foliar application of nutrients as well as growth regulators during flower initiation and pod development stages along with soil application of nutrient (Chaurasia *et al*., 2005) [4].

Materials and Methods
The field experiment was carried out during 2020-21 at experimental farm of Cotton Research Scheme, VNMKV Parbhani. The experiment was laid out in Randomized block design with eight treatments and three replications. There was eight treatments *viz*, T_1 is RDF (No spray), T_2 is RDF + 1% urea spraying, T_3 is RDF + 1% DAP spraying, T_4 is RDF + 1% 19:19:19 (N,P,K) spraying, T_5 is RDF + 1% 00:52:34 (N,P,K) spraying, T_6 is RDF + 13:00:45 (N,P,K) spraying, T_7 is RDF + 1% 13:40:13 (N,P,K) spraying and T_8- control (no RDF, no spray). Foliar application of fertilizers (1%) done at flowering and pod development stage. The treatments were allotted randomly in each replication. The recommended dose of fertilizer (25:50:25 NPK kg ha^{-1}) was applied at the time of sowing through Urea, SSP and MOP. The recommended cultural practices and plant protection measures were properly taken time to time. Five plants from all treatment were selected and labeled. These plants were used for measuring yield attributes.

Economics of chickpea

1. **Gross monetary returns (Rs ha^{-1}):** Gross monetary returns (Rs ha^{-1}) was computed on the basis of prevalent market prices of different items or products.
2. **Cost of cultivation (Rs ha^{-1}):** Total amount of expenditure (Rs ha^{-1}) in rupees required for the cultivation is the cost of cultivation.
3. **Net monetary returns (Rs ha^{-1}):** Net monetary returns (Rs ha^{-1}) was computed on the basis of prevalent market prices of different items by deducting cost of cultivation.
4. **Benefit: Cost ratio (B: C):** It is the ratio of gross return to the cost of cultivation. It can also be expressed as returns per rupee invested.

$$\text{B:C ratio} = \frac{\text{GMR (Rs. ha}^{-1})}{\text{Cost of cultivation (Rs. ha}^{-1})}$$

Results and Discussion

Effect of Foliar application of fertilizers on yield attributes

Data regarding mean number of pods plant^{-1}, seed weight plant^{-1} and seed index (g) as influenced by various foliar application of fertilizers are presented in Table 1. Significantly maximum (83.78) number of pods plant^{-1} was recorded by the T_4 - RDF + 1% 19:19:19 (NPK) spraying at flowering and pod development as compared to all other treatments. The significantly higher seed weight plant^{-1} (8.80 g) obtained in the T_4 - RDF + 1% 19:19:19 (NPK) spraying at flowering and pod development which was found at par with T_7 - RDF + 1% 13:40:13 (NPK) spraying at flowering and pod development (8.20 g) and T_5 - RDF + 1% 00:52:34 (NPK) spraying at flowering and pod development i.e. (8.10 g) however it was significantly superior over all other treatments. Seed index not influenced significantly due to Foliar application of fertilizers. Numerically highest seed index (8.53 g) was recorded with T_5 - RDF + 1% 00:52:34 (NPK) spraying at flowering and pod development stage followed by T_4- RDF + 1% 19:19:19 (NPK) spraying at flowering and pod development (8.42 g) and T_7 - RDF + 1% 13:40:13 (NPK) spraying at flowering and pod development (8.27 g). Significantly lower mean number of pods plant^{-1} (63.33), seed weight plant^{-1} (5.30) and seed index (g) (7.20) recorded with T_8 -Control (No RDF, No spray).

Table 1: Mean Number of pods, Seed weight plant^{-1} (g) and Seed Index (g) as influenced by different treatments

Treatment	No. of pods plant^{-1}	Seed weight plant^{-1} (g)	Seed Index (g)
T_1 - RDF (no spray)	69.06	6.80	7.70
T_2 - RDF + 1% Urea spraying	74.71	7.20	7.71
T_3 - RDF + 1% DAP spraying	75.36	7.50	7.75
T_4 - RDF + 1% 19:19:19 (NPK) spraying	83.78	8.80	8.42
T_5 - RDF + 1% 00:52:34 (NPK) spraying	75.89	8.10	8.53
T_6 - RDF + 1% 13:00:45 (NPK) spraying	72.75	7.20	7.84
T_7 - RDF + 1% 13:40:13 (NPK) spraying	79.24	8.20	8.27
T_8 - Control (No RDF, No spray)	63.33	5.30	7.20
S. E. (m) +	1.20	0.25	0.35
CD at 5%	3.62	0.76	NS
General Mean	74.26	7.38	7.93

Effect of Foliar application of fertilizers on yield

Data in respect of the grain yield (kg ha^{-1}) straw yield (kg ha^{-1}), biological yield (kg ha^{-1}) and harvest index (%) presented in Table 2. Data revealed that revealed that T_4 - RDF + 1% 19:19:19 (NPK) spraying at flowering and pod development resulted in significantly highest grain yield (1870kg ha^{-1}) and it was statistically at par with T_7 - RDF + 1% 13:40:13 (NPK) spraying at flowering and pod development (1778 kg ha^{-1}) and T_5 - RDF + 1% 00:52:34 (NPK) spraying at flowering and pod development (1767 kg ha^{-1}), but significantly higher than rest of treatments. T_4 - RDF + 1% 19:19:19 (NPK) spraying at flowering and pod development produced higher straw yield (2805 kg ha^{-1}) and biological yield (4675 kg ha^{-1}) it was at par with T_7 - RDF + 1% 13:40:13 (NPK) spraying at flowering and pod development (2665 kg ha^{-1}) and (4418 kg ha^{-1}) respectively. Maximum harvest index (40.32%) was recorded in T_5 - RDF + 1% 00:52:34 (NPK) spraying at flowering and pod development stage. Significantly lowest grain yield (1150 kg ha^{-1}), straw yield (1815 kg ha^{-1}), biological yield (2965 kg ha^{-1}) recorded in T_8 - Control (No RDF, No spray). These findings were in conformity with Anju *et al.*, (2017) [2], Takankhar *et al.*, (2017) [10], Jadhav and Kulkarni (2016) and Mudalagiriyappa *et al*., (2016) [7].

Table 2: Mean of Grain yield (kg ha^{-1}), Straw yield (kg ha^{-1}), Biological yield (kg ha^{-1}) and Harvest index (%) influenced by different treatment

Treatment	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Harvest Index (%)
T_1 – RDF (no spray)	1493	2299	3792	39.37
T_2- RDF + 1% Urea spraying	1570	2418	3988	39.37
T_3 - RDF + 1% DAP spraying	1630	2445	4075	40.00
T_4 - RDF + 1% 19:19:19 (NPK) spraying	1870	2805	4675	40.00
T_5- RDF + 1% 00:52:34 (NPK) spraying	1767	2575	4315	40.32
T_6- RDF + 1% 13:00:45 (NPK) spraying	1557	2351	3908	39.84
T_7- RDF + 1% 13:40:13 (NPK) spraying	1778	2665	4418	39.68
T_8– Control (No RDF, No spray)	1150	1815	2965	38.78
S. E. (m) +	44.9	53.8	102.8	-
CD at 5%	135.6	162.5	310.5	-
General Mean	1602	2422	4017	39.67

Effect of Foliar application of fertilizers on economics

Data on pertaining to the gross monetary returns, net monetary returns and benefit cost ratio (B: C ratio) of chickpea under various foliar application of fertilizers are furnished in table 3. Significantly higher gross monetary return (Rs. 93968) and net monetary returns (Rs. 57581) recorded with T_4 - RDF + 1% 19:19:19 (NPK) spraying at flowering and pod development stage and it was found at par with T_7 - RDF + 1% 13:40:13 (NPK) spraying at flowering and pod development (Rs. 89342 ha^{-1}) (Rs. 52675 ha^{-1}) and T_5 - RDF + 1% 00:52:34 (NPK) spraying at flowering and pod development (Rs. 88716 ha^{-1}) and (Rs. 51449 ha^{-1}) respectively. Significantly lowest gross monetary return (Rs. 57877 ha^{-1}), net monetary return (Rs. 23510 ha^{-1}) received in T_8 - Control (No RDF, No spray). The highest benefit: cost ratio (2.58) recorded in T_4 - RDF + 1% 19:19:19 (NPK) spraying at flowering and pod development followed by T_7 - RDF + 1% 13:40:13 (NPK) spraying at flowering and pod development (2.43). The lowest benefit: cost ratio (1.68) recorded in T_8 - Control (No RDF, No spray). These finding are well supported by the work of Mudalagiriyappa *et al*., (2016) [7], Anju *et al.,* (2017) [2], Jadhav and Kulkarni, (2016) and Shivamurthy and Biradar, (2014) [9].

Table 3: Gross monetary returns, Net monetary returns and B:C ratio as influenced by different treatments

Treatment	GMR (Rs. Ha^{-1})	NMR (Rs. Ha^{-1})	B:C ratio
T_1 - RDF (no spray)	75082	40715	2.10
T_2 - RDF + 1% Urea spraying	78955	44033	2.25
T_3 - RDF + 1% DAP spraying	81907	46844	2.33
T_4 - RDF + 1% 19:19:19 (NPK) spraying	93968	57581	2.58
T_5 - RDF + 1% 00:52:34 (NPK) spraying	88716	51449	2.38
T_6 - RDF + 1% 13:00:45 (NPK) spraying	78254	42027	2.13
T_7 - RDF + 1% 13:40:13 (NPK) spraying	89342	52675	2.43
T_8 - Control (No RDF, No spray)	57877	23510	1.68
S. E. (m) +	3381	3381	-
CD at 5%	10207	10207	-
General Mean	80512	44812	2.23

Conclusions

The foliar application of 1% 19:19:19 (NPK) or 1% 00:52:34 (NPK) or 1% 13:40:13 (NPK) spraying at flowering and pod development stage along with RDF found beneficial and productive for improving growth, growth attributes, yield and yield attributes of chickpea. For higher GMR, NMR and B:C ratio foliar application of 1% 19:19:19 (NPK) or 1% 00:52:34 (NPK) or 1% 13:40:13 (NPK) along with RDF was found beneficial in chickpea.

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