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N up take and available soil N of maize-chickpea sequence as influenced by sowing time and nitrogen management

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ABSTRACT

A field experiment was conducted on clay soils of Regional Agricultural Research Station, Lam, Guntur during *kharif* and *rabi* of 2013-14 & 2014-15 to find out the influence of time of sowing and nitrogen levels on N up take and available soil nitrogen under maize-chickpea cropping sequence under rainfed conditions. Time of sowing and nitrogen levels were significantly influenced the N up take by both grain and stover and available soil N. Higher amount of N uptake by kernel and stover of preceding maize was recorded when maize sown on the 2nd FN of June with 200 % RDN. Similarly higher N up take by grain and stover of succeeding chickpea was observed when preceding maize sown on 1st FN of July with 200 % RDN followed by 100 % RDN applied to succeeding chickpea during both the years of the study.

MATERIALS AND METHODS

A field experiment was conducted at Regional Agricultural Research Station, Lam Farm located at Guntur (Latitude:$16^0 18^1$, Longitude: $80^0 29^1$, Altitude:33 m.a.m.s.l). The climate is sub-tropical with mean annual rainfall of 950 mm. The soil of experimental field was clay loam in texture, neutral to slightly alkaline in reaction (pH 7.8 to 8.2), low in available N (204 kg ha^{-1}), high in P_2O_5 (96.5 kg ha^{-1}) and K_2O (886.5 kg ha^{-1}) and medium in organic carbon (0.51%) respectively. The experiment was conducted for two successive *kharif* and *rabi* of 2013-14 & 2014-15 in Krishna agro-climatic zone of Andhra Pradesh. The experiment consisting of three sowing windows as main plots treatments *viz*., 2nd FN of June, 1st FN of July and 2nd FN of July, three nitrogen levels as sub-plot treatments *viz*., 100 %, 150 % and 200 % RDN applied to preceding maize and four N levels as sub-sub plot treatments *viz*., 0, 50 %, 75 % and 100 % RDN to succeeding chickpea. All treatments were randomly allocated and replicated thrice in a split plot design for *kharif* crop and double split designs for *rabi* crop was adopted for both years of the experimentation. Each main plot divided in required size of three sub plots and each sub-plot again divided in to four sub-sub plots of required size. Recommended dose of N for maize was applied in three splits ($^1/_2$ at sowing, ¼ at knee high stage and ¼ at teaselling stage, respectively) to preceding maize and entire dose of N was applied at the time of sowing to succeeding chickpea. A popular and non lodging medium duration maize variety P-3396 and popular desi chickpea JG-11 were used in both the year of study. The data pertaining to soil, weather and yield attributes and yield was collected during crop growth period. Statistical analysis for drymatter partitioning and yield parameters were done following the analysis of variance technique for split and double split design as suggested by Gomez and Gomez (1984). Statistical significance was tested by applying F-test at 0.05 level of probability and critical difference (CD) were calculated for those parameters.

RESULTS AND DISCUSSION

Preceding maize

Sowing of preceding maize during the 2nd FN of June registered significantly higher N uptake (115.77 and 108.10 kg ha^{-1} during the first and second years of study, respectively), over sowing in the 2nd FN of July only and was on a par with sowing in the 1st FN of July. Significantly the lower (98.45 and 93.22 kg ha^{-1} N uptake during first and second year of experimentation, respectively) was registered by sowing in the 2nd FN of July. Increased growth and drymatter accumulation in early sowings might have resulted in the more N uptake by maize. Reduced growth and drymatter resulted the lower N uptake by the kernel. The current findings are in line with those of Maryam *et al*. (2013).

Increase in the N uptake by preceding maize with increase in the nitrogen level was observed. Significantly higher N uptake 105.11 and 104.73 kg ha^{-1} was registered by the application of 200 % RDN which was followed by 150 % RDN. Applying 200 % RDN and 150 % RDN were statistically comparable with each other. Applying 100 % RDN recorded 95.04 and 94.72 kg ha^{-1} N uptake during first and second year of the study, respectively and was significantly the lower. Increase in N uptake by preceding maize with increase in the level of nitrogen might be due to the manifestation of elevated level of nitrogen on growth and yield parameters resulting in the superior performance of maize over the lower levels. The positive response of maize at higher levels of nitrogen application could be attributed to the overall improvement in crop growth by accumulating more drymatter and increase in N uptake. The beneficial role of nitrogen in enhancing the N uptake was very well established by different workers like Padmaja *et al*. (1999), Ker *et al*. (2006), Singh *et al*. (2012) and Prathyusha *et al*. (2014).

Maize sowing during the 2nd FN of June recorded significantly higher available soil N uptake (107.88 and 107.11 kg ha^{-1} during the first and second years of study, respectively), over sowing in the 2nd FN of July only and was on a par with sowing in the 1st FN of July. Significantly lower (83.95 and 87.88 kg ha^{-1} available soil N during first and second year of experimentation, respectively) was registered by sowing in the 2nd FN of July during both the years of study. This could be due to the higher amount of nutrient availability under favourable climate in addition to the moisture and high nitrogen which caused more availability of soil N to the crop and ultimately resulting more drymatter production, grain and stover yields leading to take higher N up take by the crop led to lower availability of soil N. The current findings are in line with those of Maryam *et al*. (2013).

Succeeding chickpea

Data on nitrogen up take by succeeding chickpea presented in table 1 indicated that nitrogen levels given to preceding maize and succeeding chickpea only could significantly affect the nitrogen up take by chickpea. Neither preceding maize sowing window nor the interaction between maize sowing window and nitrogen applied to preceding maize and *rabi* chickpea could not influence the N uptake by succeeding chickpea.

Significantly the higher N up take by succeeding chickpea was observed when its preceding maize was applied with 200 % RDN that differed significantly from 100 % RDN only during the first and second year of the experimentation. The lower N up take by chickpea was observed in both the years of study when the preceding maize was applied with 100 % of RDN, applying 100 % RDN and 150 % RDN to *kharif* maize were statistically comparable. Higher available residual nitrogen and more grain yield of chickpea at higher level of nitrogen supply to *kharif* maize could be the reason for more N up take in *rabi* chickpea. The current findings are in conformity with those of earlier worker Srikrishna *et al.* (2004) and Tolanur, S.I. (2009) Nawale *et al*. (2009), Lingaraju *et al*. (2010), Jnanesha *et al* (2012) and Vidyavathi *et al*. (2012).

Significantly more N up take by chickpea seed was recorded in 100 % RDN applied to *rabi* chickpea during the first and second year of the experimentation. Lower N up take by chickpea seed was observed in control treatment. However, control treatment was statistically comparable with nitrogen application at 50% and 75% RDN to *rabi* chickpea. This could be due to higher grain yield at high N levels. These results are in conformity with the findings of earlier workers Tolanur, S.I. (2009)

CONCLUSION

It can be concluded that sowing maize during 1st FN of July with 200 % RDN followed with 100 % RDN to succeeding chickpea was found higher N uptake both the crops and lower available soil N under maize-chickpea crop sequence.

Table 1 Nitrogen up take by preceding maize and available soil N

Treatments Main Plots	N Up take (kg ha^{-1}) Kernel		N Up take (kg ha^{-1}) Stover		Available soil N (kg ha^{-1})		Grain yield (Kg ha^{-1})	
Maize sowing window (A)	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
2st FN of June	115.77	108.10	108.10	107.13	107.88	107.11	9552.00	9487.00
1nd FN of July	105.93	98.86	98.86	102.26	99.19	97.44	9348.00	9283.00
2st FN of July	98.45	93.22	93.22	89.92	83.95	87.88	7771.00	7706.00
SEm ±	**2.94**	**2.93**	**3.27**	**3.84**	**4.16**	**4.15**	**318.94**	**318.94**
CD (0.05)	**11.56**	**11.49**	**12.82**	**15.10**	**16.34**	**16.31**	**1252.31**	**252.30**
CV (%)	**8.25**	**8.72**	**9.30**	**10.51**	**9.05**	**9.04**	**10.76**	**10.84**
Sub-Plots: Nitrogen Levels (B) applied to maize								
100% RDN	100.05	95.04	95.06	94.70	90.24	90.10	9477.00	9292.00
150% RDN	107.00	100.03	100.10	99.80	96.84	97.20	12385.00	12179.00
200% RDN	113.09	105.11	105.14	104.70	103.93	105.12	12202.00	12112.00
SEm ±	**2.91**	**1.85**	**3.47**	**3.16**	**4.12**	**2.63**	**365.21**	**385.47**
CD (0.05)	**8.97**	**5.70**	**10.68**	**9.74**	**12.68**	**8.11**	**1125.33**	**1187.73**
CV (%)	**8.15**	**5.51**	**8.81**	**8.66**	**8.95**	**5.73**	**9.65**	**10.30**
Interaction				**NS**				

Table 2 Nitrogen up take by succeeding chickpea and available soil N

Treatments Main Plots	N Up take (kg ha^{-1}) Grain		N Up take (kg ha^{-1}) Stover		Available soil N (kg ha^{-1})		Grain yield (Kg ha^{-1})	
Maize sowing window (A)	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
2st FN of June	62.60	57.67	51.03	51.41	139.61	142.50	1335	1325
1nd FN of July	62.08	58.07	51.66	51.5	140.55	144.53	1743	1742
2st FN of July	62.27	56.62	51.60	51.29	139.50	141.53	1550	1539
SEm ±	**0.49**	**0.53**	**0.52**	**0.51**	**1.27**	**1.33**	**8.99**	**12.20**
CD (0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**27.55**	**33.52**
CV (%)	**4.81**	**6.18**	**4.81**	**6.18**	**8.75**	**8.84**	**2.72**	**3.34**
Sub-Plots: Nitrogen Levels (B) applied to maize								
100% RDN	61.23	56.92	50.78	50.74	138.53	142.27	1405	1399
150% RDN	62.36	57.26	50.95	51.36	139.08	142.62	1477	1472
200% RDN	63.36	58.18	52.55	52.12	142.05	143.66	1749	1735
SEm ±	**0.40**	**0.41**	**0.53**	**0.41**	**2.12**	**1.20**	**12.53**	**24.99**
CD (0.05)	**1.28**	**1.27**	**1.64**	**1.28**	**NS**	**NS**	**37.90**	**76.47**
CV (%)	**6.22**	**5.03**	**6.22**	**5.03**	**10.74**	**10.85**	**4.80**	**9.70**
Sub-Sub plots: Nitrogen Levels (C) applied to chickpea								
0 % RDN	61.60	56.61	50.67	50.86	135.78	140.71	1224	1220
50 % RDN	62.23	57.21	51.21	51.27	138.40	141.05	1462	1448
75 % RDN	62.45	57.79	51.30	51.27	142.30	142.26	1637	1629
100 % RDN	62.98	58.19	52.54	52.24	143.07	147.38	1852	1845
SEm ±	**0.41**	**0.46**	**0.6**	**0.46**	**2.38**	**2.28**	**16.59**	**27.39**
CD (0.05)	**1.18**	**1.29**	**1.69**	**1.30**	**6.80**	**6.74**	**49.80**	**82.20**
CV (%)	**6.03**	**4.83**	**6.03**	**4.83**	**4.14**	**4.03**	**5.90**	**9.81**
Interaction (AxBxC)						**NS**		

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