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Residual Effect of Gypsum on Growth, Yield and Nutrient Uptake by Onion (*Allium cepa* L.) under Groundnut-Onion Cropping Sequence

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Abstract The field experiment was conducted during the *rabi* season of 2010. The experiment was laid out in randomized block design with three replications. The experiment comprised five treatment combinations. The treatment details are T_0–Control (no input), T_1–NPK (25 : 50 : 20 kg ha^{-1}) + Gypsum @ 100 kg ha^{-1}, T_2–NPK (25 : 50 : 20 kg ha^{-1}) + Gypsum @ 200 kg ha^{-1}, T_3–NPK (25 : 50 : 20 kg ha^{-1}) +Gypsum @ 300 kg ha^{-1}, T_4–NPK (25 : 50 : 20 kg ha^{-1}) + Gypsum @ 400 kg ha^{-1}. The soil of experimental field was silt loam in texture having pH 7.5, EC 0.28 dSm^{-1} and organic carbon 0.52%. The results revealed the significant effect of treatment on plant height over control at 90 DAS. The maximum values were recorded with the application of treatment T_4–NPK (25 : 50 : 20 kg ha^{-1}) + Gypsum @ 400 kg ha^{-1}. Similarly, result was also found in respect of nutrient uptake by crop in this same treatment.

Keywords Gypsum, Onion, Sulfur, Bulb, Yield.

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Introduction

Onion (*Allium cepa* L.) is one of the most important commercial vegetable crop grown in the country. Onion protect against cancer, heart disease, loo, inner side wounded and also cause antifungal activities due to a phenolic factor i.e. catechol. Sulfur is one of the essential element for plant growth. Sulfur containing secondary compounds also provides resistance against pest and diseases [1]. Onion are known for their affinity to sulfur because sulfur is a constituent of secondary compounds i.e. allin, cycloallin and thiopropanol [2] therein. Sulfur is essential for formation of proteins because of sulfur is found in cystine, cysteine and methionine, amino acids that make up plant proteins. Sulfur improves both yield and quality of crops [3, 4]. Studies have indicated that deficiency of sulfur is increasing due to continuous use of S- free fertilizers and is more conspicuous in light textured soils low in organic matter. Calcium nutrition is often considered a yield limiting factor. Adequate supply of available calcium in the fruiting zone is extremely important to facilitate diffusion of calcium from soil solution to developing bulbs.

Materials and Methods

The field experiment was conducted during the *rabi* season of 2010 at research plots of the Department of Agricultural Chemistry and Soil Science, Udai Pratap

Table 1. Residual effect of gypsum on growth, yield of onion and nutrient uptake under groundnut-onion cropping sequence.

Treatments	Plant height (cm) 30 DAT	60 DAT	90 DAT	Yield (q/ha) Foliage (Dry)	Bulb	Nutrient content (%) N (%)	S (%)	Nutrient uptake (kg/ha) N uptake	S uptake
T_0	12.94	37.08	40.00	8.20	263.6	0.23	0.083	1.88	0.68
T_1	18.72	40.04	48.50	9.50	307.5	0.40	0.114	3.80	1.08
T_2	18.92	38.58	47.60	9.70	315.5	0.91	0.136	8.83	1.32
T_3	19.50	40.83	49.60	9.90	320.0	1.50	0.139	14.85	1.38
T_4	20.21	43.60	51.00	10.50	341.0	1.70	0.157	17.85	1.65
CD (p= 0.05)	NS	NS	2.25	1.90	18.0	0.16	NS	2.91	0.61

Autonomous College, Varanasi. The soil samples were collected randomly from 10 places of the experimental field with the help of soil auger and analyzed it. The soil of experimental field was silt loam in texture having pH 7.5, EC 0.28 dSm^{-1}, organic carbon 0.52% and medium in nitrogen (180.2 kg ha^{-1}), low in phosphorus (12.00 kg ha^{-1}), medium in potassium (129.00 kg ha^{-1}) and available sulfur (12.00 kg ha^{-1}). The experiment comprised in to five treatment combinations. The treatment details are as T_0= Control (No input), T_1–NPK (25 : 50 : 20 kg ha^{-1})+Gypsum @ 100 kg ha^{-1}, T_2– NP (25 : 50 : 20 kg ha^{-1})+ Gypsum @ 200 kg ha^{-1}, T_3–NPK (25 : 50 : 20 kg ha^{-1}) + Gypsum @ 300 kg ha^{-1}, T_4–NPK (25 : 50 : 20 kg ha^{-1})+Gypsum @ 400 kg ha^{-1}. The experiment was laid out in randomized block design with thrice replication. The variety sown was Nasik red with spacing 15 × 10 cm. Recommended doses of NPK were applied in crop. Full dose of phosphorus, potassium and half dose of nitrogen were applied as basal application at the time of sowing. Gypsum was applied as per treatments wise. The data were recorded randomly from five places in each plot on growth and yield attributing and yield. The data recorded in respect to different observations were analyzed as per standard statistical procedure

Results and Discussion

Residual effect of gypsum on plant height

Various treatments were not affected significantly on the plant height of the crop at 30 and 60 DAS but it was found significant at 90 DAS. The data pertaining to plant height of crop is given in Table 1. Among the treatments, the highest plant height (23.38 cm) was recorded with treatment T_4–(NPK–25 : 50 : 20 kg ha^{-1} + Gypsum @ 400 kg ha^{-1}) which was significant superior over rest of the treatments at 90 DAS. However, there was no significant difference between T_4 and T_3 treatment. Results related to residual effect of gypsum on onion indicates that plant height increased due to applied gypsum in previous groundnut crop. Maximum height was found with applied gypsum at 400 kg ha^{-1}. Significant increase was noted at 90 days of transplanting stage. The results are conforming to earlier reports [4, 5]. Gypsum application improves the chemical properties in term of marginal decrease in pH, which on reaction with native calcium releases the calcium in soil solution. These may due to increasing rate of gypsum significantly increased growth. Sulfur increased rate of photosynthesis due to enhance the protein synthesis and maintenance of high chlorophyll content. Thus, it ultimately increases the plant growth. Similar results were found earlier [6].

Residual effect of gypsum on yield

Data showed that residual gypsum significantly effected yield as compared to control. The maximum bulb yield (341 q ha^{-1}) was recorded under application of T_4–(NPK-25 : 50 : 20 kg ha^{-1} + Gypsum@ 400 kg ha^{-1}) which was significantly superior over other treatments. While, the maximum foliage yield (10.50 q ha^{-1}) was recorded under application of T_4– (NPK - 25 : 50 : 20 kg ha^{-1} + Gypsum @ 400 kg ha^{-1}) which was significantly superior over control. There was not significantly difference among the treatments. Gypsum

Table 2. Effect of treatments on soil pH, OC and water soluble Ca^{++} status of soil.

Treatments	pH		OC (%)		Ca^{++} (MeL^{-1})	
	45 DAT	At harvest	45 DAT	At harvest	45 DAT	At harvest
T_0	7.68	6.55	0.51	0.43	1.70	1.30
T_1	7.83	6.93	0.67	0.52	2.60	1.96
T_2	7.88	7.28	0.66	0.61	2.73	2.20
T_3	8.18	7.61	0.79	0.73	3.16	2.60
T_4	8.36	7.61	0.72	0.64	3.30	2.86
CD (p = 0.05)	NS	0.489	NS	0.28	NS	NS

and sulfur application improved significantly plant biomass, and Chlorophyll content in leaf exhibited significant positive correlation with bulb and foliage yield. Similar results were reported earlier [7, 8].

Residual effect of gypsum on nutrient content in plant

The data related to nitrogen and sulfur content in plant (foliage) has been presented in Table 1. It is evident from data that the application of gypsum in previous groundnut crop significantly increased the nitrogen content in plant foliage of onion as compared to control. The maximum nitrogen content was recorded under application of T_4 (1.7%) which was significantly superior over rest of treatments. Further, the application of gypsum increased the sulfur content in plant as compared to control. However, it did not influence significantly on sulfur content in plant. The maximum sulfur content was found in treatment T_4 (0.157%) and lowest in control T_0 (0.083%). Similar results were reported earlier [9].

Residual effect of gypsum on nutrient uptake by plant

The data related to uptake of N by foliage at harvest has been presented in Table 1. The data that nitrogen uptake varied from 1.88 to 17.85 kg ha^{-1} and sulfur uptake by plant varied from 0.68 to 1.65 kg ha^{-1}. The maximum uptake of nitrogen was recorded with the application of T_4 (Gypsum @ 400 kg ha^{-1}) followed by other treatments in the order of $T_3 > T_2 > T_1 > T_0$. Applied gypsum in previous crop significantly increased the uptake. T_4 was found to be significantly superior over other treatments. The maximum sulfur uptake by plant was found in treatment T_4 (1.65 kg ha^{-1}) which was found at par to T_3 and T_2 and which was significantly superior to T_1 and control. Similar results were reported earlier [9].

Effect on pH, organic carbon and Ca^{++} soluble

The various treatments were not effect significantly on soil pH at 45 DAS, but it influenced significantly at harvest stage in Table 2. The maximum soil organic carbon was recorded under application of T_4 followed by other treatments in order of $T_3 > T_2 > T_1 > T_0$. However, the various treatments were not effect significantly on Ca^{++} soluble in soil. These results are well conforming to earlier reports [8].

On the basis of finding it is concluded that the application of gypsum in previous crop increased crop yield and nutrient uptake by crop as compared to control. The application of treatment T_4 – (NPK 25: 50 : 20 kg ha^{-1} + Gypsum @ 400 kg ha^{-1}) was found best treatment among the treatment.

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