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Scientific evaluation of the putative traits for optimization of potash application to groundnut under water stress condition in Odisha

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Abstract

A field experiment entitled "Physiological and biochemical basis of growth, yield and drought tolerance in groundnut by application of potash" was conducted at central farm OUAT, Bhubaneswar under AICRP on groundnut, Department of Agronomy during Rabi-Summer 2014-2015. The physiological studies were carried out in the department of Plant Physiology, College of Agriculture, Bhubaneswar. Groundnut variety Devi was taken for study and the experiment was laid out in a Randomized Block Design with 8 treatments and replicated thrice. The treatments were comprised off T1: control(no NPK) T2: farmers practice (N:P:K:: 18:46:30 kg/ha) T3: RD of NPK @ 20:40:40 kg/ha T4: NPK @ 20:40:60 kg/ha T5: NPK @ 20:40:80 kg/ha all at sowing T6: NPK @20:40:20 kg/ha at sowing and 20 kg/ha at flowering (30 DAS) T8: NPK @ 20:40:40 kg/ha at sowing and 40kg/ha at flowering (30 DAS).

The result revealed that plant height, number of branches, number of leaves, number of nodules, TDM were improved by the level and timing of K application. Among the treatments application of 60 and 80 kg/ha in split registered significant increase of the above growth character in groundnut crop which reflected a higher value of LAI, LAD, CGR and RGR. The physiological traits for stress tolerance of a crop significantly influenced by the level of K and timing of its application. A significant increase of these traits was noticed when the level of K was increased up to 80 kg/ha and applied to groundnut crop in splits except RWD which decreased significantly with increase in the level of K application. The highest value of these biochemical characteristics of groundnut crop were recorded at 80 kg/ha when applied in splits at sowing and flowering. The seed yield in groundnut increased significantly with increase in the level of K application due to increase in number of pods per plant, shelling percentage and kernel weight and the highest yield registered among the treatments at 80 kg/ha when applied in split. In view of the positive and beneficial effect of K application in groundnut crop it may be concluded that improvement in the productivity of groundnut crop under residual soil moisture condition can be possible through split application of K up to 80 kg/ha.

Keywords: Scientific evaluation, putative traits, groundnut, water stress condition

Introduction

Groundnut is tolerance to water stress condition. Groundnut is a buffer crop. This crop has the in built morphological and biological structure by the nature so that Groundnut plant can cope up with various adverse conditions like water stress condition. Potash Absorption Ratio (KAR) is higher in case of groundnut in order to maintain ionic equilibrium.

In view of above facts the present experiment was undertaken to study the physiological and biochemical basis of stress tolerance of groundnut by application of potash.

Materials and methods

The Researchers were followed the Research Design of Randomized Block Design(RBD) in order to get error free and concrete results.10 Replications had been made in order to maintain clarity. One Control Plot and Rest treated plot were used for making successful experiment. A Concrete Farm Plan and Calendar was followed strictly by practising suitable Package of practices and intercultural operation from time to time under the guidance of Plant Physiologist, Agronomist and Soil Scientists. Various meteorological data was recorded from OUAT Meteorological Department. Statistical analysis and various tests had been conducted to get proper conclusion.

Result

Biochemical traits

NRA and Proline content

Nitrate reductase activity (NRA) and proline content of leaves estimated at 45 and 60 DAS (Table-9) indicated that values of both the biochemical traits were higher at 45 DAS compared

to 60DAS. NRA varied among the treatments which ranged within (15.3 to 32.1 $\mu\text{g No}_2/\text{g fresh wt/ hr}$) at 45 DAS and 12.5 to 30.06 $\mu\text{g No}_2/\text{g fresh wt/hr}$ at 60 DAS. The highest NRA was recorded in T₈ and the lowest NRA in control (T₁) at both stages 45 and 60 DAS. NRA increased with increase in the level of K application but significant increase in NRA at both stages was recorded in the leaves of plants supplied in split with 60 kg K/ha (T₇) and 80 kg K /ha (T₈) over control. However the enzyme activity between T₇ and T₈ were found at par.

Variation in proline content was found among the treatments at both 45 and 60 DAS. It was recorded in the range of 68.3 to 102.2 $\mu\text{g/g}$ at 45 DAS and 50.6 to 99.6 $\mu\text{g/g}$ at 60 DAS. Among the treatments the highest and the lowest proline content was recorded in T₈ and T₁ respectively at both 45 and

60 DAS. Increase in the level of K application also increased the proline content but significant increase was recorded in plants supplied with K in split at the rate of 60 kg/ha (T₇) and 80 kg/ha (T₈). However no significant difference was found between T₇ and T₈.

Uptake of N P K

Uptake of N, P and K by kernel, haulm and whole plant at harvest were presented in table-11. Result indicated that uptake of N, P and K was more in haulm than kernel. The total uptake of these nutrients were in the order of N uptake > K uptake > P uptake.

Uptake of N by kernel, haulm and whole plant was influenced by level and time of K application. The variation in N uptake by plant parts and whole plant among the

Table 1: Effect of levels and time of potash application on N, P and k uptake by Kernel and Haulm of groundnut

Treatments	N uptake (g/plant)			P uptake (g/plant)			K uptake(g/plant)		
	Kernel	Haulm	Total	Kernel	Haulm	Total	Kernel	Haulm	Total
T ₁	0.34	0.63	0.97	0.02	0.04	0.06	0.13	0.19	0.32
T ₂	0.37	0.64	1.01	0.02	0.05	0.07	0.14	0.21	0.35
T ₃	0.38	0.65	1.03	0.02	0.05	0.07	0.15	0.24	0.39
T ₄	0.40	0.69	1.09	0.03	0.06	0.09	0.19	0.27	0.46
T ₅	0.41	0.72	1.13	0.03	0.06	0.09	0.20	0.29	0.49
T ₆	0.40	0.73	1.13	0.03	0.05	0.08	0.17	0.25	0.42
T ₇	0.42	0.76	1.18	0.04	0.06	0.10	0.21	0.31	0.52
T ₈	0.46	0.76	1.22	0.04	0.06	0.10	0.23	0.34	0.57
SEM	0.02	0.04	0.07	0.004	0.003	0.01	0.011	0.017	0.063
CD 5%	0.06	0.12	0.21	0.012	0.011	0.03	0.035	0.052	0.189

Treatments were recorded in the range of 0.34 to 0.46g in kernel, 0.63 to 0.76g in haulm and 0.97 to 1.22g per plant. The lowest uptake was recorded in T₁ and the highest uptake in T₈. Uptake of N by plant parts and whole plant increased with the level of K application but significant increase over control was recorded for 60 and 80 kg K/ha weather applied in single dose or in split. However, no significant difference was noticed in N uptake by plant and plant parts between these two doses of K application.

The uptake of P by plant and plant parts such as kernel and haulm influenced by the level and time of K application. The variation recorded among the treatments for P uptake was found in the range of 0.02 to 0.04g for kernel, 0.04 to 0.06g for haulm and 0.06 to 0.10g for whole plant. Among the treatments, the maximum and the minimum uptake of P by kernel and haulm as well as whole plant were recorded in T₈ and T₁ respectively. Significant increase in P uptake by plant and plant parts were noticed in groundnut crop grown with 80kg K/ha in two splits (T₈) which were at par with (T₇) where plants supplied with 60 kg K /ha in two splits.

Uptake of K by kernel and haulm as well as whole plant was influenced by the level and time of K application. The variation in K uptake among the treatments found in the range of 0.13 to 0.23g in kernel, 0.19 to 0.34g in haulm and 0.32 to 0.57g per plant. The highest and the lowest uptake were recorded in T₈ and T₁ respectively. Increase in K level

increased the K uptake by plant and plant parts but significant increase was recorded in plants supplied with 60 and 80 kg K/ha which applied in two splits. However, no significant difference was found between these two levels of K application with respect to k uptake by plant or plant parts.

Yield, yield attributes and oil content

Yield, yield attributing characters and oil content were presented in Table.

Number of pods per plant increased significantly with increase in the level of K application over control (T₁) where groundnut was grown without any fertilizer. The highest number of pods (22.6) per plant was recorded in crop grown with 80kg K /ha applied in split at sowing and flowering (T₈) which was at par with (T₇). But Significant increase in pods per plant was also noticed in split application of K only at 80 kg/ha (T₈).

Shelling percent varied among the treatments. The highest shelling percent (77.8%) was recorded in T₈ and the lowest (69%) in T₁ among the treatments. Significant increase in shelling percent over control was noticed at 60 and 80 kg K/ha applied either in single or in split doses and at 40kg K/ha when applied in split. Application of K in split doses significantly increased the shelling percent over single dose application only at 80 kg K/ha.

Table 2: Effect of levels and time of potash application on Yield and Yield attributes of groundnut

Treatments	No. of Pods/Plant	Shelling percent (%)	HKW (g)	Pod yield (g/plant)	Pod Yield (kg/ha)	HI	Oil content (%)
T ₁	13.2	69.0	35.8	4.72	2008	33.48	43.9
T ₂	14.5	69.4	37.5	5.48	2091	33.60	44.8
T ₃	16.7	71.2	37.7	6.29	2305	34.67	45.7
T ₄	18.3	72.9	38.3	6.36	2353	34.86	46.2
T ₅	18.8	74.1	38.5	7.00	2364	34.58	48.2
T ₆	18.0	72.3	39.3	7.074	2445	35.03	46.3
T ₇	20.0	76.3	39.8	7.96	2605	35.94	48.4
T ₈	22.6	77.8	40.2	9.08	2794	36.04	49.8
SEM	1.136	1	1.03	0.444	82.60	0.46	0.70
CD 5%	3.44	3.0	3.1	1.346	247	1.39	2.1

Variation in hundred kernel weight (HKW) was noticed among the treatments. The highest HKW (40.2 g) and the lowest (35.8g) were recorded in T₈ and T₁ respectively. Increased in HKW was noticed with increase in K levels but significant increase over control was registered when 40 (T₆), 60 (T₇) and 80 kg K /ha (T₈) was applied in split doses at sowing and flowering. But, no significant difference was noticed among these treatments w.r.t HKW.

Pod yield per plant varied among the treatments. The highest pod yield (9.08g) per plant and lowest pod yield (4.72g) per plant were recorded in T₈ and T₁ respectively. Significant increase in pod yield per plant over control was obtained with increase in K application up to 40 kg/ha but when split application was compared with single dose application of K, significant increase was registered both at 80 kg K/ha (T₈) compared to its counterpart. However no significant difference was noticed between T₇ and T₈.

Pod yield per hectare showed similar trend as it was found in pod yield per plant.

HI varied among the treatments. The highest HI (36) and lowest HI (33.5) were recorded in T₈ and T₁ respectively among the treatments. Increase in the K level increased the HI in T₅ T₆, T₇ and T₈ over control but significant increase was registered only at 80 kg K /ha applied in split (T₈) over single dose application.

Oil content varied from 43.9 to 49.8%. Among the treatments, the highest and lowest oil content was recorded in T₈ and T₁ respectively. Oil content increased with increases in K application but significant increase over control was recorded at 60 and 80 kg K/ha either applied in single dose or in split. Application of 40 kg K/ha in split also registered significant increase in oil content over control. Though higher oil content found due to split application of K but significant increase was noticed only in T₇ compared to single dose application.

Discussion

The investigation was undertaken in field condition during rabi 2014-15 to study the effect of potash on growth, yield and drought tolerance in groundnut crop. The data relating to various morpho-physiological and biochemical characters studied during the course of investigation and interpreted on the preceding chapter were discussed in this chapter under these following heads.

- Leaf water potential (WP), MC, RWC and RWD of leaf considered as putative traits for drought tolerance were influenced by the level and timing of K application in groundnut crop. Increase in the level of K increased WP, MC and RWC but decreased RWD. Among the treatments the highest WP, MC and RWC and reducing RWD of leaves in groundnut crop. However no significant difference was noticed among T₆, T₇ and T₈.
- NRA recorded at two stages of plant growth indicated higher value of 45 and 60 DAS. The highest NRA was found in T₈ applied with 80 kg K/ha in two splits while lowest in control (T₁) among the treatments. Significant increase in this enzyme activity was noticed in T₈ which was at par with T₇. Split doses showed higher enzyme activity than single dose of K.
- Proline an important osmolyte associated with drought tolerance ability of a plant, showed higher value at 45 than 60 DAS. Among the treatments the highest and the lowest uptake of these three nutrients, in plant parts as well as by whole plant was found in T₈ and T₁ respectively at both growth stages. Increase in the level of K also increased the proline content but significant

increase was noticed in plants supplied with K in split doses at 60 kg/ha (T₇) and 80 kg/ha (T₈). However no significant difference was marked between these two treatments.

- Uptake of N,P and K was influenced by the level and timing of K application. The uptake of these nutrients was more in haulm than kernel. Irrespective of the treatments the total uptake of N > K > P. among the treatments the highest and the lowest uptake of these three nutrients in plant parts as well as by whole plant was found in T₈ and T₁ respectively. Uptake of N, P and K by different plant parts and whole plant increased with increase in the K level but significant increase was noticed at 60 kg/ha (T₇) and 80 kg/ha(T₈) when applied in split. Uptake of nutrients by plant and plant parts was better under split application of K than its single application. However T₇ and T₈ didn't show significant difference with respect to nutrient uptake.
- Yield and yield components viz. pods/plant, shelling percentage, 100 kernel weight influenced by the level and timing of K application.
- Number of pods per plant increased significantly with increase in the level of application over control. Among the treatments the highest and the lowest number of pods per plant was recorded in T₈ and T₁ respectively. Split application of K produced more number of pods per plant but significantly increase was observed at 80 kg/ha (T₈).
- Shelling percent was highest in T₈ and lowest in T₁ among the treatments. Significant percent was highest in T₈ and lowest in T₁ among the treatments. Significant increase in the shelling percent over control was noticed at 60 and 80 kg/ha either in single or in split doses and 40 kg/ha when applied in split. Split application of K increase the shelling percent better than its single application.
- Among the treatments hundred kernel weight was maximum in T₈ and minimum in T₁. Increase in K level increase the kernel weight but significant increase over control was found when 40, 60 and 80 kg/ha were applied in split doses. However no significant difference was noticed among those treatments with respect to HKW.
- Pod yield per plant and hectare yield increased with increase in the level of K. the highest yield was found in T₈ followed by T₇ and lowest yield was recorded in T₁. Split application of K produce more yield than its single application.
- The highest and the lowest HI was found in T₈ and T₁ respectively among the treatments. Increase in K level increased the HI but significant increase was observed at 80 kg K/ha when applied in split (T₈) over its single application.
- Oil content of seed was influenced by the level and timing of K application in groundnut crop. Among the treatments the highest and lowest oil content was recorded in T₈ and T₁ respectively. Oil content increase with increase in the level of K but significant increase was observed at 60 and 80 kg/ha over control either applied in single dose or in split. Application of 40 kg K/ha in split also registered significant increase in oil content over control. Split application found better than single application of K in improving the oil content in seed of groundnut.

Conclusion

The Research Finds the suitable technology for the Farmers

so that the farmers may able to apply Potash with proper dosages as per the recommended scientific practices.

In view of the positive and beneficial effect of Potash application on growth, yield and drought tolerance ability of groundnut crop it may be concluded that improvement in the productivity of groundnut crop under low soil moisture or residual soil moisture condition can be possible through increased application of K up to 80-120 kg/ha in split at sowing and flowering.

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