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Effect of potash levels and apportioning time on yield and economic of summer groundnut under drip irrigation

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Abstract
A field experiment on Effect of potash levels and apportioning time on yield and economic of summer groundnut under drip irrigation was carried out at All India Co-ordinated Research Project on Summer Groundnut, M.P.K.V., Rahuri. The pod and hualm yield were significantly increased under groundnut crop grown with potash level 30 kg K_2O ha^{-1} as compared to other potash levels. The dry pod yield kg ha^1, kernel yield kg ha^{-1} and dry haulm yield kg ha^{-1} were significantly increased in potash apportioning time at 75 DAS with 10 splits. The potash level 30 kg K_2O ha^{-1} significantly increased gross and net monetary returns as compared to other potash levels. The gross monetary returns (Rs. 171807 ha^{-1}), net monetary returns (Rs. 110793 ha^{-1}) and B:C ratio (2.82) were recorded with 30 kg K_2O ha^{-1}. Treatment K3 *i.e.* 30 kg K_2O ha^{-1} yielded better results than other potash levels. The gross (Rs. 157135 ha^{-1}) and net monetary returns (Rs. 95985 ha^{-1}) and B:C ratio (2.57) were significantly more at potash apportioning time 75 DAS with 10 splits followed by potash apportioning time at 60 DAS with 8 splits.

Keywords: potash, drip irrigation, B:C ratio, groundnut

Introduction

Groundnut (*Arachis hypogaea* L.), is king of oilseeds belongs to the family Leguminoceae and is commonly called as poor man's almond. The peanut kernels contain 45-55% oil and 25-34% protein and are the fourth most important source of edible oil and the third most important source of protein in the world. Though high in fat, peanut primarily contains good fat (unsaturated and free from trans types) and helps to maintain blood cholesterol levels and therefore friendly to heart. In India, peanut is one of the important oilseed crops and occupies an area of 5.86 M ha with the production of 8.27 M tonnes and productivity of 1411 kg ha^{-1} (2010-11) which is quite low as compared to other countries. Among the various factors that limit the productivity of peanut, efficient use of available water and fertilizer is highly critical for improving the crop productivity. It has been reported that the loss of applied irrigation water from the reservoir to the field under unlined irrigation system is 71% in furrow and border irrigation systems (Navalawala, 1991) [12]. Such huge amounts of water loss cause abundant nutrient loss through seepage/percolation. However, drip irrigation reduces deep percolation and evaporation and controls soil water status more precisely within the crop root zone. Similarly, during fertigation, fertilizers are applied through emitters directly in the zone of maximum root activity, and consequently, fertilizer-use efficiency can be improved over conventional broadcasting / furrow placement method of fertilizer application. It has been scientifically recognized that adoption of drip fertigation method is an option for efficient use of water and nutrients through improvement in crop yield per unit volume of water and nutrients used. There is a reduction in water consumption by 30-70% by use of drip system over surface method with a concomitant gain in productivity by 20-30% for different crops (Jayakumar *et al.* 2014 [9]; Singh *et al.* 2009 [18]; Thind *et al.* 2008 [21]). A review on the use of fertigation by Jat *et al.* (2011) [8] from ICRISAT, Hyderabad, suggested that to make agriculture sustainable and economically viable, there is a need to promote fertigation on a large scale by the concerned stakeholders / farmers. Over and above, fertigation by means drip irrigation clearly assures the saving of two important resources, water, and nutrient, and thus economically viable for farmers by one-time cost investment of drip system installation. Studies showed that drip irrigated peanut had greater yield, market grade, and gross revenue compared with non-irrigated regimes (Sorensen and Lamb, 2009) [19].

Further, appropriate irrigation interval is an important parameter in managing irrigation which shows the time of irrigation in the program. With suitable irrigation interval, the crop is not influenced by stress resulted from water and wastage of water and energy is minimized as well. It is also equally important to decide at what interval irrigation water should be applied to any crop for its judicious and efficient management keeping in mind the scarcity of this precious resource. Caldwell *et al.* (1994) [5] also showed that frequencies of 1, 3, 5, or 7 days produced similar high corn yields. However, higher irrigation water-use efficiencies were obtained as high as 7 days frequency because of reduction in deep percolation below the root zone. It was found that maximum yield of maize, soybean, and peanut were obtained under irrigation interval of 10-15 days (Partowiyoto *et al.,* 1996) [14] under conventional method of irrigation. However, it was found that pod, seed and oil yield, and water-use efficiency were higher with higher irrigation rate in peanut (Sujith *et al.,* 2000) [20]. The possible frequent irrigation by drip is believed to be the main reason for the betterment of quality and quantity of the crop yield as the frequent irrigation leads to lessen the chances of moisture stress.

Currently potash fertilizer dose is not recommended for groundnut crop. Also potash plays important role in groundnut production. Under water deficit conditions, potash nutrition increases crop tolerance to water stress by utilizing the soil moisture more efficiently than in potash-deficient plants. The positive effects of potash on water stress tolerance may be through promotion of root growth accompanied by a greater uptake of nutrients and water by plants. Potassium is known for its ability to increase yield and improve quality. The very meager work on application and apportioning time of potash fertilizer is done on groundnut crop. Review of the research study in respect of use of drip irrigation system and use of potash for groundnut production indicates that there is a scope to study the production of groundnut. In view of this, the present study was undertaken.

Material and Methods

A field experiment was undertaken during summer season 2016-17 at All India Co-ordinated Summer Groundnut Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra). The soil was clay loam in texture, low in available nitrogen, medium in available phosphorus and high in potassium. The moisture content at field capacity and permanent wilting point were 32.16 and 16.02 per cent respectively. The bulk density was 1.38 Mg cm^{-3}. The soil was alkaline in reaction (pH 8.36). The experiment was carried out in split plot design with three replications. The experiment consisted of three potash levels as a main plot *viz.*, K1- 10 kg K_2O ha^{-1}, K2 - 20 kg K_2O ha^{-1}, K3- 30 kg K_2O ha^{-1} and four potash apportioning time as a sub plot *viz.*,T1- 30 DAS (3 splits), T2- 45 DAS (6 splits), T3- 60 DAS (8 splits) and T4- 75 DAS (10 splits). Groundnut variety 'Phule Unnati' constituted the experimental material. The gross and net plot sizes were 5.00 × 3.90 m^2 and 4.60 × 2.85 m^2, respectively. Drip irrigation systems with pressure compensating drippers were laid out as per treatments. Single lateral was laid per row with emitter spacing as 0.50 m. The drip laterals were made up of linear low density polyethylene (LLDPE) with size of 16 mm. Type of sub main used was 63 mm PVC pipe. Small control valve was connected at beginning of each lateral to facilitate irrigation and fertigation as per treatment. The operating head at emitters was 1.00 kg cm^2 or 10 meter of height of water. Quantity of water applied as per treatment was calculated by recording daily pan evaporation. The recommended fertilizer dose (25:50 kg N and P_2O_5 ha^{-1}) was applied through urea (46 percent N), single super phosphate and K_2O was applied through MOP as per treatment.

Result

Effect of potash levels

The pod and hualm yield were significantly increased under groundnut crop grown with potash level 30 kg K_2O ha^{-1} (4333 kg ha^{-1} and 7147 kg ha^{-1} respectively) as compared to other potash levels (Table 1). Pod weight $plant^{-1}$ and hualm weight $plant^{-1}$ (24.98 g and 42.32 g respectively) is higher in 30 kg K_2O ha^{-1} potash level compared to 10 and 20 kg K_2O ha^{-1} potash level. The potash level 20 kg K_2O ha^{-1} was at par with 30 kg K_2O ha^{-1} for dry pod weight $plant^{-1}$. Jana *et al.* (1990) [7] reported that addition of K up to 49.8 kg ha^{-1} had increased the number of pods $plant^{-1}$, number of seeds pod^{-1}, 100 seed weight, pod and oil yield. However, pod yield and haulm yield of peanut increased significantly with application of 40 kg K_2O ha^{-1} over lower dose and further, increase beyond this level did not increase the yield. Munda *et al.,* (2004) [11] observed increased branches per plant from 9.9 to 10.1 and number of pods $plant^{-1}$ from 9.2 to 12.3 when 20:60:40 kg N, P_2O_5 and K_2O ha^{-1} was applied to groundnut as compared to control. Pradyut *et al.,* (2006) [16] reported that applications of potassium @ 180 kg K_2O gave highest yield but were statistically at par with 120 kg K_2O ha^{-1} or even 60 kg K_2O ha^{-1}. However its economic dose was 96.3 kg K_2O ha^{-1} in groundnut.

Borah *et al.*, (2017) [3] reported that the yield of dry pod, kernel and haulm of *kharif* groundnut were increased significantly with increasing levels of potassium and highest yields (31.69, 22.13, and 38.94 q ha^{-1}, respectively) were recorded by application of 40 kg K_2O ha^{-1}. Significant increase in yield and uptake were reported with higher dose potassium *i.e.* 40 kg ha^{-1} and among different potassium sources SOP (Borah *et al.*, 2018) [4]. Basith (1992) [2] reported that application of 30 kg K_2O ha^{-1} increased significantly the uptake of N and P_2O_5 as well as K_20 over control at different stages of crop growth in groundnut. Potassium resulted in a significant increase in the number of leaves and height, K contents (50-70 g kg^{-1}) and grain yield, obtaining 2790 kg ha^{-1} at a dose of 120 kg ha^{-1} (Almeida *et al.*, 2015) [1]. Mouri *et al.*, (2018) [10] reported that BARI Cheenabadam-8 should preferably be fertilized with 60 kg P ha^{-1} to obtain the highest yield.

Effect of apportioning time

The number of pods $plant^{-1}$, dry pod yield kg ha^{-1}, kernel yield kg ha^{-1} and dry haulm yield kg ha^{-1} (2433, 3968 kg ha^{-1}, 2541 kg ha^{-1} and 6291 kg ha^{-1}, respectively) were significantly increased in potash apportioning time at 75 DAS with 10 splits and remained at par with 60 DAS apportioning in respect of number of pods $plant^{-1}$, dry haulm yield and kernel yield kg ha^{-1} (Table 1). This may be attributed to increased values of growth *viz.*, plant height, number of branches, leaf area and dry matter production $plant^{-1}$ and yield contributing characters *viz.*, number and weight of pods apportioning time at 75 DAS (10 splits). The K+ ions are flushed away by frequent irrigation before they can be taken up by the crop hence, only a small fraction reaches the plants regardless of fertilizer dose, and the rest is wasted. Approach to overcome this problem is to split the K dose into many frequent applications, thus increasing the chances for K uptake. Due to that potash apportioning time at 75 DAS with 10 splits give better performance in summer groundnut. Deshmukh *et al.*, (1992) [6] reported that pod and haulm yield and total nutrient uptake of NPK in groundnut were significantly increased with the split application (75 % of K at sowing and 25 % at flowering stage. Patro *et al.*, (2018) [15] studied that advantage to the split K application at the highest dose tested. Due to an increased number of fertile pods per plant, pod yield was 30% higher than under control conditions, in addition to greater kernel weight and higher shelling rates. It may be concluded that split K application is far better for groundnut crops.

Table 1: Dry pod yield and Economics of groundnut as influenced by potash level and apportioning time in groundnut

Treatments	Dry pod yield kg ha^{-1}	Dry haulm yield kg ha^{-1}	Kernel yield kg ha^{-1}	Gross Monetary Return (Rs ha-1)	Cost of cultivation (Rs ha-1)	Net Monetary Return (Rs ha-1)	B:C Ratio (Rs ha-1)
Main Plot: (Potash levels)							
K_1: 10 kg K2 ha^{-1}	3167	4683	1902	126440	63404	61657	1.97
K_2: 20 kg K2 ha^{-1}	3731	5910	2362	147629	63665	83964	2.32
K_3: 30 kg K2 ha^{-1}	4333	7147	2818	171807	64038	107769	2.68
SE (m) ±	40	167	37	1966.6		2056.5	0.035
CD at 5%	157	657	146	7721		8075	0.13
Sub Plot: Apportioning time							
Application of potash uniformly in equal splits at weekly interval at							
T_1 - 30 DAS (3 Splits)	3527	5418	2194	141248	60268	76141	2.20
T_2 - 45 DAS (6 Splits)	3673	5830	2296	145373	63495	81878	2.29
T_3 - 60 DAS (8 Splits)	3806	6115	2412	150745	63872	86873	2.36
T_4 - 75 DAS (10 Splits)	3968	6291	2541	157135	64175	92961	2.45
SE (m) ±	46	121	45	3240.8		2107.6	0.035
CD at 5%	136	359	133	9629		6262	0.10
A) Interactions							
Between potash levels means at same level of apportioning time							
SE (m) ±	79	209	77	5613.3		3650.6	0.061
CD at 5%	235	NS	NS	NS		NS	NS
Between apportioning time means at same level of potash levels							
SE (m) ±	79	247	77	5244		3771.6	0.063
CD at 5%	255	NS	NS	NS		NS	NS
General Mean	3743	5914	2361	148625	63703	84463	2.32

Economics

The potash level 30 kg K_2O ha^{-1} significantly increased gross and net monetary returns as compared to other potash levels. The gross monetary returns (Rs. 171807 ha^{-1}), net monetary returns (Rs. 110793 ha^{-1}) and B:C ratio (2.82) were recorded with 30 kg K_2O ha^{-1}. Treatment K3 *i.e.* 30 kg K_2O ha^{-1} yielded better results than other potash levels. The gross (Rs. 157135 ha^{-1}) and net monetary returns (Rs. 95985 ha^{-1}) and B:C ratio (2.57) were significantly more at potash apportioning time 75 DAS with 10 splits followed by potash apportioning time at 60 DAS with 8 splits . This may be attributed to significant increase in growth attributes and yield contributing reflected in higher values. Zhou *et al.* (2003) [22] reported that the yield and economic benefit of peanut were decreased obviously when the amount of applied potassium was over 225 $kg.hm^{-2}$. Thus, the prescription of N150, P75 and K150 was recommended for the balance fertilization of peanut production in this region. Sanadi *et al.*, (2018) [17] reported the treatment with 150 per cent RDK through muriate of potash in split (half as basal + half at 30 DAS) plus 1 per cent foliar spray through potassium sulphate at 60 DAS (T8) recorded higher B:C ratio (2.65) whereas control recorded the lowest B:C ratio (2.28). Palsande *et al.*, (2019) [13] reported maximum net returns and B:C ratio were recorded in the treatment K2 (30 kg K_2O ha^{-1}).

Conclusion

On the basis of results obtained, it will be concluded that application of potash level @ 30 K_2O kg ha^{-1} + apportioning time up to 75 DAS with 10 splits to summer groundnut is beneficial for higher growth, yield and B:C ratio in groundnut than the other potash levels and apportioning time under study.

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