

Effect of Irrigation Scheduling and Phosphogypsum Levels on Yield Attributes, Yield and Available Nutrients in Soil after Harvest of *Rabi* Groundnut

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ABSTRACT

The field experiment was conducted at College farm, Acharya N. G. Ranga Agricultural University (now Professor Jayashankar Telangana State Agricultural University), Rajendranagar, Hyderabad during rabi 2013-14. The experiment was laid out in split plot with combinations of three moisture regimes viz., 0.6, 0.8 and 1.0 IW/CPE ratios and five phosphogypsum fertilizer levels viz., Pg₁: Control (500 kg ha⁻¹ gypsum at flower initiation), Pg₂: Phosphogypsum @ 250 kg ha⁻¹ at flower initiation, Pg₃: Phosphogypsum @ 250 kg ha⁻¹ (½ as basal and ½ at flower initiation), Pg₄: Phosphogypsum @ 500 kg ha⁻¹ (½ as basal and ½ at flower initiation), Pg₅: Phosphogypsum @ 500 kg ha⁻¹ at flower initiation and was replicated thrice. Among moisture regimes highest yield attributes and yield were obtained with I₃(1.0 IW/CPE) moisture regime but highest available nutrients in soil after harvest of groundnut were recorded with I₁(0.6 IW/CPE) moisture regime. Among phosphogypsum levels highest yield attributes, yield and available nutrients in soil after harvest of groundnut were obtained with Pg₅: Phosphogypsum @ 500 kg ha⁻¹ at flower initiation.

Key words: Phosphogypsum, Moisture regimes, Groundnut, Available nutrient in soil.

INTRODUCTION

Groundnut is an important oil and protein source to a large portion of the population in India. It is an annual, herbaceous legume and considered as king of vegetable oil seed crops in India and occupies a pre-eminent position in national edible oil economy. Groundnut seed contain 47-53 per cent oil, 26 per cent protein

and 11.5 per cent starch. It is currently grown in an area of 42 Million hectares over the globe. Cultivation of groundnut under rainfed conditions and imbalanced nutrient management are the main reasons for low productivity of groundnut in Andhra Pradesh. Irrigation water, a crucial input in crop production is scarce and expensive.

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Efficient use of this input is essential which can be achieved through judicious water management practices. Adequate and timely supply of water is essential for higher yields. Keeping the total quantity of irrigation water constant, increasing the frequency of irrigation would maximize the yield in groundnut⁴.

Groundnut is grown during rainy, winter and summer seasons in India. The average productivity is relatively low in rainy season. Groundnut has specific moisture needs due to its peculiar feature of producing pods underground. In groundnut early moisture stress restricts the vegetative growth which in turn reduces the yield and at the peak flowering and pegging period is most sensitive as the peg cannot penetrate through dry and hard surface. The rabi crop avails the residual moisture and the scanty rainfall during winter and produces substantial yield as compared to the kharif crop and few supplementary irrigations would improve the yield. Because of high productivity under assured irrigation, groundnut cultivation in rabi season is gaining popularity in irrigation scheduling, a climatologically approach based on IW/CPE ratio (IW- irrigation water, CPE- Cumulative pan evaporation) has been found most appropriate. This approach integrates all the weather parameters that determine water use by the crop and is likely to increase production at least 15-20%. Optimum scheduling of irrigation led to increase in pod yield and water use efficiency (WUE)¹³.

To ensure increased yields of *rabi* groundnut in traditional areas of Andhra Pradesh and Telangana it is necessary to have a thorough understanding of the changes in the soil-plant-water relations and various morpho-physiological processes in relation to scheduling of irrigation water. Studies on various aspects of groundnut nutrition are limited particularly under varied soil moisture regimes, hence efforts are needed to quantify the crop response *vis-a-vis*at different nutrient levels.

Among the sources of sulphur, phosphogypsum is cheaper and potential source. It is a solid waste by-product of the

wet phosphoric acid production from rock phosphate. Phosphogypsum contains 16 per cent sulphur and 21 per cent calcium along with meagre amount of phosphorus (0.2-1.2 % P₂O₅) and trace amounts of silica (SiO₂), iron (Fe₂O₃), aluminium (Al₂O₃), sodium (Na₂O), potassium (K₂O) and some heavy metals (Biswas and Sharma, 2008). Approximately 5.5 Million tonnes of phosphogypsum is discharged for every one Million tonnes of phosphoric acid production. In India, 6 to 8 Million tonnes of phosphogypsum is produced annually which supplies 1 to 1.5 Million tonnes of sulphur and 1.5 to 2 Million tonnes of calcium.

The phosphogypsum, unlike other sulphur sources, offers all desirable agronomic features of an efficient sulphur fertilizer besides supplying calcium that is readily available to the growing plant, while elemental sulphur and organic sulphur must undergo microbial conversion before sulphur is made available to plants, but the sulphur in phosphogypsum becomes readily available in sulphate form. At the same time, sulphate form is kept available for a longer period due to its low solubility in water. Most of the other sulphate salts that are used for fertilizer are highly soluble and the sulphate may be leached from the soil before the plant removal².

In spite of additional nutritional value and desirable agronomic features, a high proportion is either dumped or staked for increasing concern to the risk of exposure to radiation. However, the relative radiation risk to people or the environment falls significantly below the level of radiation to which we are exposed through Naturally Occurring Radioactive Material (NORM). Hence, it may not be prudent, therefore, to allow such wastage of this large sulphur and calcium rich by-product (16% S and 21% Ca) in the back drop of wide spread sulphur and calcium deficiencies in Indian soils². Keeping this in view, this study was undertaken to investigate the influence of moisture regimes and phosphogypsum levels on growth and yield of *rabi* groundnut.

MATERIAL AND METHODS

Field experiment was conducted at College farm, Acharya N. G. Ranga Agricultural University, Rajendranagar, Hyderabad during *rabi* 2013-14 on sandy loam soil having low organic carbon (0.53 %) and available nitrogen (238.33 kg ha⁻¹), medium available phosphorous (29.33 kg ha⁻¹), sulphur and calcium (14.30 and 10.00 kg ha⁻¹), high potassium (423.36 kg ha⁻¹) and neutral in reaction.

The experiment was laid out in split plot design with combinations of three moisture regimes *viz.*, 0.6, 0.8 and 1.0 IW/CPE ratios and five phosphogypsum fertilizer levels *viz.*, Pg₁: Control (500 kg ha⁻¹ gypsum at flower initiation), Pg₂: Phosphogypsum @ 250 kg ha⁻¹ (at flower initiation), Pg₃: Phosphogypsum @ 250 kg ha⁻¹ (½ as basal and ½ at flower initiation), Pg₄: Phosphogypsum @ 500 kg ha⁻¹ (½ as basal and ½ at flower initiation), Pg₅: Phosphogypsum @ 500 kg ha⁻¹ (at flower initiation) and was replicated thrice. Groundnut variety K-6 (Kadiri-6) was sown on 10-10-2013 at a spacing of 22.5 cm x 10 cm with one seed hill⁻¹. Recommended N P K applied to all the treatments uniformly @ 30: 50: 50 kg ha⁻¹. Nitrogen and Phosphorus applied through urea and DAP, potassium through muriate of potash. Whole quantity of phosphorus and potassium and ½ nitrogen applied as basal and remaining ½ Nitrogen as top dressing at 25-30 DAS. Mean maximum and minimum temperatures were 32.8°C and 22.1°C respectively and 282.2 mm rainfall was received in 11 rainy days during the crop growing period. Mean bulk density and total available soil moisture in 60 cm depth of soil was 1.6 g cm⁻³ and 127.6 mm respectively. Mean moisture percentage at field capacity and permanent wilting point was 19.2 and 5.9. The total applied irrigation water was 267, 222 and 178 ha.mm for IW/CPE ratio of 1.0, 0.8 and 0.6 respectively. Five, four and three irrigations were given to IW/CPE ratio of 1.0, 0.8 and 0.6 respectively along with one irrigation to all treatments one day before harvesting. For every irrigation, 50 mm of water was applied using water meter in closed

channels. Daily readings of evaporation were recorded from USWB class "A" open pan evaporimeter and irrigations were scheduled based on IW/CPE ratios.

Yield attributes and yield were recorded at harvest, while quality and economics were recorded after harvest of groundnut. Statistical analysis was done to all the recorded data as per Panse and Sukhatme⁵.

RESULTS AND DISCUSSION

The data pertaining to yield attributes was presented in Table 1. Yield attributes *viz.*, number of pods plant⁻¹, number of kernels Pod⁻¹, 100 kernel weight (g), shelling percentage were significantly higher by moisture regime at I₃ (1.0 IW/CPE) and it was on par at I₂ (0.8 IW/CPE) only with number of pods plant⁻¹, number of kernels pod⁻¹, 100 kernel weight (g), shelling percentage but superior over other treatments. Frequent irrigation under I₃ treatment might have created favorable moisture conditions for the crop growth consequently increased the values of the yield attributes than other treatments (I₁ and I₂). These results are in close conformity with the findings of Santosh Behera *et al.*, Patel *et al.*⁶, Dey *et al.*³, and Shaikh *et al.*⁸.

Among the phosphogypsum levels, application of phosphogypsum @ 500 kg ha⁻¹ at flower initiation recorded significantly maximum yield attributes and statistically on par with application of gypsum @ 500 kg ha⁻¹ at flower initiation with all yield attributes except number of pods plant⁻¹. Among yield attributes interaction between moisture regimes and phosphogypsum levels was significant with number of pods plant⁻¹. Significantly highest number of pods plant⁻¹ (15.8) observed at interaction of I₃ (1.0 IW/CPE) and phosphogypsum @ 500 kg ha⁻¹ at flower initiation (Pg₅) followed by I₂Pg₅ and I₃Pg₂ respectively. Lowest number of pods plant⁻¹ (12.2) recorded at interaction of I₁Pg₃ (0.6 IW/CPE) (phosphogypsum @ 250 kg ha⁻¹ ½ as basal and ½ at flower initiation). It was observed that there was marked improvement in yield attributes which might be due to balanced nutrition resulting in the production

of greater pod number and shelling percentage. The probable reason could be efficient and greater partitioning of metabolites and adequate translocation of nutrients to the developing reproductive parts. These results are in close conformity with the findings of Surendra singh and Singh¹¹, Somnathchattopaddhyay and goutamkumar ghosh⁹, Rout and Jena⁷, and Dey *et al.*³.

The data pertaining to groundnut pod and haulm yield were presented in Table 1, fig.1 and fig.2. The highest pod and haulm yields (21.5 and 38.4 q ha⁻¹) were recorded when irrigation was scheduled at I₃ (1.0 IW/CPE), which was on par with I₂ (0.8 IW/CPE) treatment and both were significantly superior from remaining levels of irrigation. The lowest yields (17.4 and 32.3 q ha⁻¹) were regarded with I₁ (0.6 IW/CPE) treatment compared to other treatments. The higher pod and haulm yields with more frequent irrigation (I₃) might have accounted for their favorable influence on the growth (plant height, number of branches per plant, dry matter accumulation and leaf area index, respectively) and yield attributing characters (number of pods per plant, number of kernels pod⁻¹, 100 kernel weight, respectively). Pod and haulm yield of groundnut was significantly increased with increase in the frequency of irrigation which was ascribed to adequate moisture availability in turns have favored congenial conditions for the luxurious growth of crop and consequently increased the values of the yield attributes with I₃ compare to I₂ and I₁ treatments. These results are in close conformity with the findings of Santosh Behera *et al.*, Suresh *et al.*¹², and Shaikhet *et al.*⁸.

Among the phosphogypsum levels, application of phosphogypsum @ 500 kg ha⁻¹ at flower initiation were recorded maximum pod and haulm yields (21.4 and 37.6 q ha⁻¹) but in which only haulm yield was on par with gypsum application @ 500 kg ha⁻¹ at flower initiation. Lowest pod and haulm yields (17.9 and 34.4 q ha⁻¹) were recorded under Pg₃ (phosphogypsum @ 250 kg ha⁻¹ ½ as basal and ½ at flower initiation) treatment.

Phosphogypsum application @ 500 kg ha⁻¹ at flowering stage might have ensured adequate supply of calcium and sulphur, have favored not only in pod formation but also in better filling of the pods thus would have increased number of filled pods, shelling percentage and 100 kernel weight.

The results of the experiment clearly suggest that phosphogypsum is also efficient in increasing the pod and yield of groundnut similar to that of gypsum. The higher pod and haulm yield with application of phosphogypsum @ 500 kg ha⁻¹ might attributed for their favorable influence on the growth (plant height, number of branches plant⁻¹, dry matter accumulation and leaf area index) and yield attributing characters (number of pods per plant, number of kernels pod⁻¹, 100 kernel weight). As phosphogypsum has relatively low solubility as compared to highly soluble S carriers, availability of S is made for a longer period. These results are in close conformity with the findings of Surendrasingh and Singh¹¹, Somnathchattopaddhyay and goutamkumarghosh, Rout and Jena⁷.

The interaction of moisture regimes and phosphogypsum levels on pod and haulm yields data presented in Table:1.b and fig.3 The interaction effect between moisture regimes and phosphogypsum levels showed that significantly highest pod yield (23.03 q ha⁻¹) observed at interaction level I₃ (1.0 IW/CPE) and phosphogypsum @ 500 kg ha⁻¹ at flower initiation (Pg₅), which was on par with I₃Pg₁, I₂Pg₅, I₃Pg₂, I₂Pg₄, I₂Pg₁, I₃Pg₄, I₂Pg₂ respectively. Lowest pod yield (15.6 q ha⁻¹) observed at interaction level I₁Pg₃ (0.6 IW/CPE and phosphogypsum @ 250 kg ha⁻¹ ½ as basal and ½ at flower initiation). The interaction effect between moisture regimes and phosphogypsum levels showed that significantly highest haulm yield obtained at interaction I₂Pg₅ followed by I₃Pg₂, I₂Pg₁ and I₃Pg₁ interactions respectively. Lowest haulm yield observed at I₁Pg₂ interaction.

The data pertaining to pH, EC, organic carbon (OC) of groundnut was presented in Table 2. Soil pH, EC, organic carbon of groundnut in final soil was not significantly

influenced by moisture regimes. The highest final soil N (211 kg ha⁻¹), P (34.4 kg ha⁻¹), K (445 kg ha⁻¹), S (25.1 ppm) and Ca (17.1 me 100 g⁻¹ soil) nutrients were recorded under I₁ (0.6 IW/CPE) treatment. Lowest final soil N (194 kg ha⁻¹), P (32.5 kg ha⁻¹), K (436 kg ha⁻¹), S (20.2 ppm) and Ca (15.6 me 100 g⁻¹ soil) nutrients were recorded under I₃ (1.0 IW/CPE) treatment.

Among the phosphogypsum levels, soil pH, EC, organic carbon of groundnut in final soil was not significantly influenced by phosphogypsum levels. The highest final soil N (216 kg ha⁻¹), P (36.0 kg ha⁻¹), K (454 kg ha⁻¹), S (26.4 ppm) and Ca (19.0 me 100 g⁻¹ soil) nutrients values were recorded under phosphogypsum @ 500 kg ha⁻¹ at flower initiation (Pg₅) when compared to all other treatments, in this only K and S both on par with Pg₁ (gypsum @ 500 kg ha⁻¹ at flower

initiation (Pg₁). Lowest final soil N (193 kg ha⁻¹) at Pg₁ (gypsum @ 500 kg ha⁻¹ at flower initiation (Pg₁), P (31.2 kg ha⁻¹), K (427 kg ha⁻¹), S (17.2 ppm) and Ca (14.8 me 100 g⁻¹ soil) nutrients were recorded under Pg₃ (phosphogypsum 250 kg ha⁻¹ ½ as basal and ½ at flower initiation) treatment. The interaction effect between moisture regimes and phosphogypsum levels showed (Table:2.a and fig.4) that significantly superior final soil nitrogen (220 kg ha⁻¹) observed with interaction level phosphogypsum @ 500 kg ha⁻¹ at flower initiation (Pg₅) and at I₁ (1.0 IW/CPE) moisture regimes which was on par with I₂Pg₅, I₁Pg₃, I₁Pg₂, I₃Pg₅. Lowest final soil nitrogen (184 kg ha⁻¹) observed at interaction level I₃ (1.0 IW/CPE) and @ 500 kg ha⁻¹ at flower initiation (Pg₁). These results are in close conformity with the findings of Nayaket *al.*, and Rout and Jena⁷.

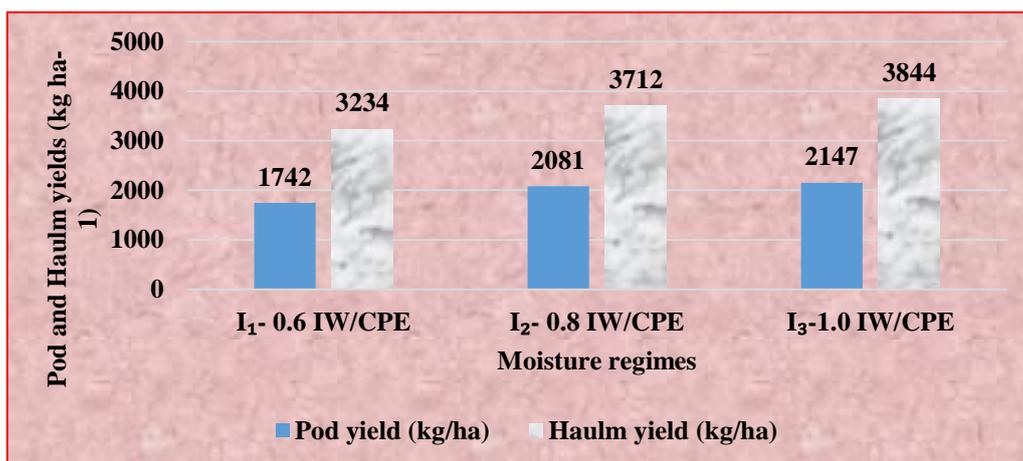


Fig. 1: Effect of moisture regimes on pod yield and haulm yield (kg ha⁻¹) of rabi groundnut

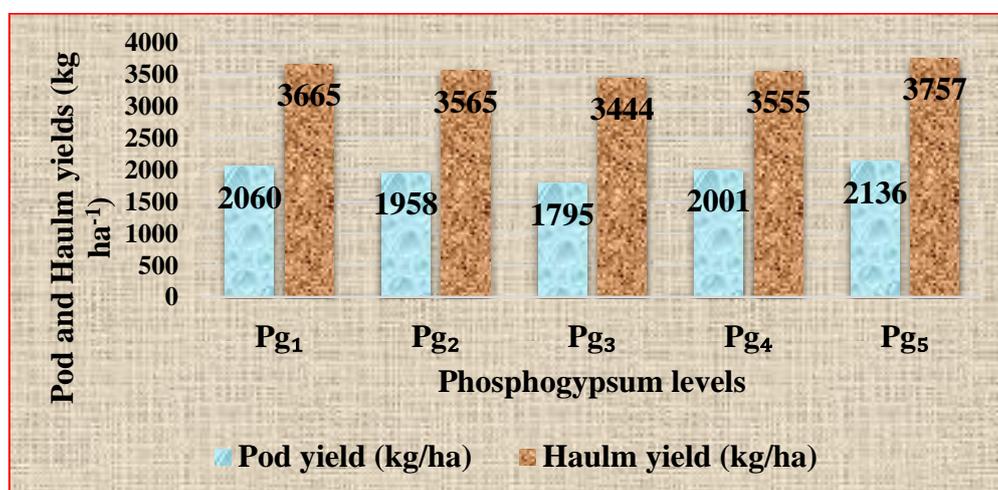


Fig. 2: Effect of phosphogypsum levels on pod yield and haulm yield (kg ha⁻¹) of rabi groundnut

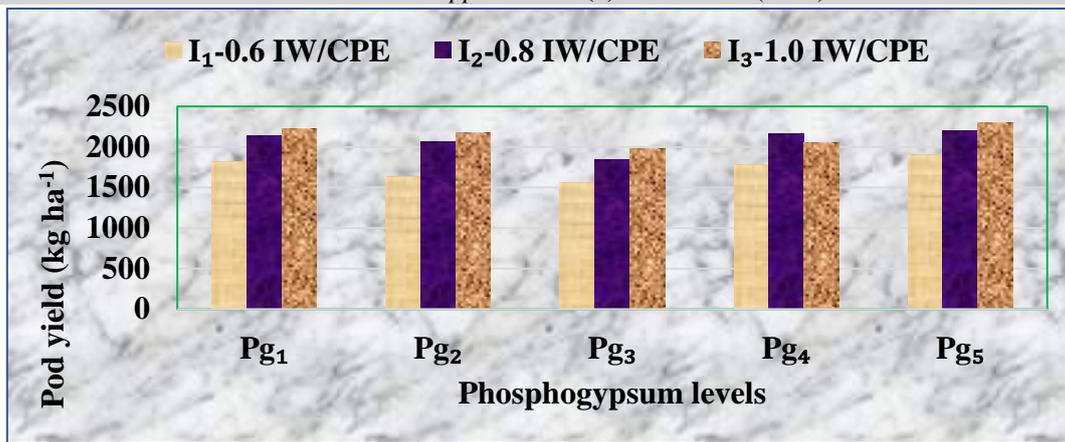


Fig. 3: Interaction effect of moisture regimes and phosphogypsum levels on pod yield (kg ha⁻¹)

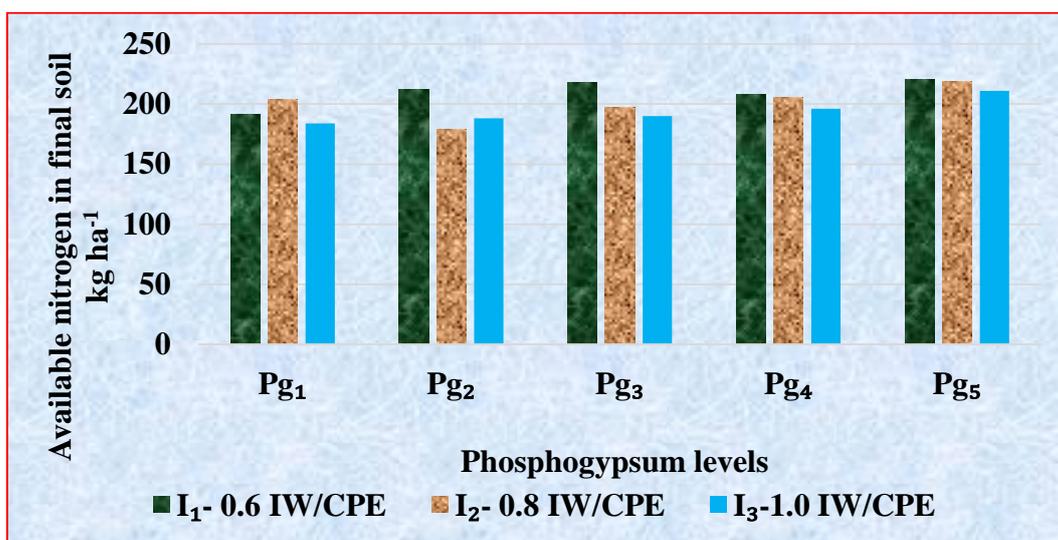


Fig. 4: Interaction effect of moisture regimes and phosphogypsum levels on available nitrogen at harvest (kg ha⁻¹)

Table 1: Yield and yield attributing characters of *rabi* groundnut as influenced by moisture regimes and phosphogypsum levels

TREATMENTS	YIELD ATTRIBUTES				Yield (kg ha ⁻¹)	
	No. of Pods Plant ⁻¹	No. of Kernels Pod ⁻¹	100 Kernel Weight (g)	Shelling %	Pod Yield	Haulm Yield
MOISTURE REGIMES (I)						
I ₁ -0.6 IW/CPE	13.0	1.47	40.1	64.7	1742	3234
I ₂ -0.8 IW/CPE	13.7	1.50	41.0	68.0	2081	3719
I ₃ -1.0 IW/CPE	14.1	1.52	41.4	69.8	2147	3799
SEm±	0.1	0.01	0.2	0.8	18	28
CD (P=0.05)	0.5	0.03	0.8	3.2	73	109
PHOSPHOGYPSUM LEVELS (Pg)						
Pg ₁ -Gypsum@500 kg ha ⁻¹ at flower initiation	13.7	1.5	41.3	68.2	2060	3665
Pg ₂ -PG @250 kg ha ⁻¹ at flower initiation	13.3	1.5	40.2	66.8	1958	3556
Pg ₃ - PG @250 kg ha ⁻¹ ½ as basal and ½ at flower initiation	13.0	1.5	40.0	64.9	1795	3444
Pg ₄ - PG @500 kg ha ⁻¹ ½ as basal and ½ at flower initiation	13.4	1.5	40.7	67.1	2001	3555
Pg ₅ - PG @500 kg ha ⁻¹ at flower initiation	14.6	1.6	42.1	70.6	2136	3701
SEm±	0.1	0.03	0.4	0.8	20	55
CD (P=0.05)	0.4	0.1	1.0	2.4	59	161
INTERACTION (I x Pg)						
Sub treatment at same level of main treatment						
SEm±	0.3	0.02	0.5	1.9	41	62
CD (P=0.05)	0.8	NS	NS	NS	36	287
Main treatment at same level of sub treatment						
SEm±	0.3	0.1	0.6	1.5	111	90
CD (P=0.05)	0.8	NS	NS	NS	116	270

Pg- Phosphogypsum

Table 1:a. Number of pods plant⁻¹ of *rabi* groundnut as influenced by interaction between moisture regimes and phosphogypsum levels

PHOSPHOGYPSUM LEVELS	MOISTURE REGIMES			MEAN
	I ₁ (0.6IW/CPE)	I ₂ (0.8 IW/CPE)	I ₃ (1.0 IW/CPE)	
Pg ₁ -Gypsum@ 500 kg ha ⁻¹ at flower initiation	14.5	13.8	12.6	13.7
Pg ₂ -PG @ 250 kg ha ⁻¹ at flower initiation	12.5	12.7	14.7	13.3
Pg ₃ - PG @ 250 kg ha ⁻¹ ½ as basal and ½ at flower initiation	12.2	13.0	13.7	13.0
Pg ₄ - PG @ 500 kg ha ⁻¹ ½ as basal and ½ at flower initiation	12.6	14.1	13.5	13.4
Pg ₅ - PG @ 500 kg ha ⁻¹ at flower initiation	13.3	14.7	15.8	14.6
MEAN	13.0	13.7	14.1	13.6
Sub treatment at same level of main treatment				
SEm±				0.3
CD (P=0.05)				0.8
Main treatment at same or different level of sub treatment				
SEm±				0.3
CD (P=0.05)				0.8

Table1:b. Pod Yield and haulm yield (kg ha⁻¹) of *rabi* groundnut as influenced by interaction between moisture regimes and phosphogypsum levels

PHOSPHOGYPSUM LEVELS	Pod yield (kg ha ⁻¹)				Haulm yield (kg ha ⁻¹)			
	MOISTURE REGIMES			MEAN	MOISTURE REGIMES			MEAN
	I ₁ -0.6 IW/CPE	I ₂ -0.8 IW/CPE	I ₃ -1.0 IW/CPE		I ₁ -0.6 IW/CPE	I ₂ -0.8 IW/CPE	I ₃ -1.0 IW/CPE	
Pg ₁ -Gypsum@500 kg ha ⁻¹ at flower initiation	1820	2134	2224	2060	3351	3822	3821	3665
Pg ₂ -PG @250 kg ha ⁻¹ at flower initiation	1634	2064	2175	1958	3046	3641	3982	3556
Pg ₃ - PG @250 kg ha ⁻¹ ½ as basal and ½ at flower initiation	1560	1848	1978	1795	3262	3371	3698	3444
Pg ₄ - PG @500 kg ha ⁻¹ ½ as basal and ½ at flower initiation	1788	2162	2054	2001	3100	3775	3789	3555
Pg ₅ - PG @500 kg ha ⁻¹ at flower initiation	1908	2197	2303	2136	3411	3985	3706	3701
MEAN	1742	2081	2147	1990	3234	3719	3799	3584
Sub treatment at same level of main treatment								
SEm±				41				
CD (P=0.05)				111				
Main treatment at same level of sub treatment								
SEm±				36				
CD (P=0.05)				116				

Table 2: Physico- chemical and chemical properties of the soil after crop harvest as influenced by moisture regimes and phosphogypsum levels

TREATMENTS	EC (dSm ⁻¹)	pH	OC (%)	Nitrogen (kg ha ⁻¹)	Phosphorus (kg ha ⁻¹)	Potash (kg ha ⁻¹)	Sulphur (ppm or ug)	Calcium (me 100 g ⁻¹ soil)
Initial values	0.140	7.52	0.535	238.3	29.3	423	14.3	10.0
MOISTURE REGIMES (I)								
I ₁ -0.6 IW/CPE	0.146	7.38	0.524	211.0	34.4	445	25.1	17.1
I ₂ -0.8 IW/CPE	0.153	7.31	0.523	200.0	33.1	439	23.1	16.0
I ₃ -1.0 IW/CPE	0.158	7.26	0.522	194.0	32.5	436	20.2	15.6
SEm±	0.006	0.05	0.0	2.1	0.2	1.4	0.6	0.1
CD (P=0.05)	NS	NS	NS	8.2	0.8	4.5	2.3	0.5
PHOSPHOGYPSUM LEVELS (Pg)								
Pg ₁ -Gypsum@ 500kg ha ⁻¹ at flower initiation	0.154	7.29	0.523	193.0	34.2	450	25.9	16.1
Pg ₂ -PG @ 250kg ha ⁻¹ at flower initiation	0.150	7.32	0.522	196.0	33.2	434	21.4	15.4
Pg ₃ - PG @ 250kg ha ⁻¹ ½ as basal and ½ at flower initiation	0.146	7.41	0.527	202.0	31.2	427	17.2	14.8
Pg ₄ - PG @ 500kg ha ⁻¹ ½ as basal and ½ at flower initiation	0.154	7.31	0.524	203.0	32.1	436	23.1	16.1
Pg ₅ - PG @ 500kg ha ⁻¹ at flower initiation	0.158	7.27	0.518	217.0	36.0	454	26.4	19
SEm±	0.014	0.04	0.003	2.2	0.3	2.8	0.7	0.1
CD (P=0.05)	NS	NS	NS	6.3	0.8	8.0	2.0	0.2
INTERACTION (I x Pg)								
Sub treatment at same level of main treatment								
SEm±	0.013	0.10	0.003	4.7	0.5	3.1	1.3	0.3
CD (P=0.05)	NS	NS	NS	3.9	NS	NS	NS	NS
Main treatment at same or different level of sub treatment								
SEm±	0.023	0.07	0.005	12.0	0.5	4.5	1.2	0.5
CD (P=0.05)	NS	NS	NS	12.6	NS	NS	NS	NS

Table 2:a. Available nitrogen (kg ha⁻¹) in soil after harvest of *rabi* groundnut as influenced by interaction between moisture regimes and phosphogypsum levels

PHOSPHOGYPSUM LEVELS	MOISTURE REGIMES			MEAN
	I ₁ (0.6 IW/CPE)	I ₂ (0.8 IW/CPE)	I ₃ (1.0 IW/CPE)	
Pg ₁ -Gypsum@ 500kg ha ⁻¹ at flower initiation	191	204	184	193
Pg ₂ -PG @ 250kg ha ⁻¹ at flower initiation	212	179	188	193
Pg ₃ - PG @ 250kg ha ⁻¹ ½ as basal and ½ at flower initiation	218	197	190	202
Pg ₄ - PG @ 500kg ha ⁻¹ ½ as basal and ½ at flower initiation	208	205	196	203
Pg ₅ - PG @ 500kg ha ⁻¹ at flower initiation	220	219	211	217
MEAN	211	200	194	198
Sub treatment at same level of main treatment				
SEm±				4.7
CD (P=0.05)				11.0
Main treatment at same or different level of sub treatment				
SEm±				3.7
CD (P=0.05)				11.9

CONCLUSIONS

From the study it can be concluded that, scheduling irrigation at I₃ (1.0 IW/CPE) resulted in higher yield attributes, yields (pod & haulm). Among phosphogypsum levels application of phosphogypsum @ 500 kg ha⁻¹ at flower initiation recorded higher yield attributes and yields in *rabi* groundnut. Soil pH, EC, organic carbon of groundnut in final soil was not significantly influenced by moisture regimes as well as phosphogypsum levels. After harvest of *rabi* groundnut the highest final soil nutrients were recorded under scheduling irrigation I₁(0.6 IW/CPE) i.e: Nitrogen, Phosphorus, Potassium, Sulphur and Calcium and among phosphogypsum levels the highest final soil nutrients were recorded under phosphogypsum @ 500 kg ha⁻¹ at flower initiation.

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