E-ISSN: 2618-0618
P-ISSN: 2618-060X

NAAS Rating (2025): 5.20
www.agronomyjournals.com
2025; 8(9): 773-778
Received: 18-07-2025
Accepted: 19-08-2025

Sravani B
Department of Agronomy, College of Agriculture, Professor Jayashankar Telangana Agricultural University, Rajendranagar, Telangana, India

Sridhar K
AICRP on Integrated Farming Systems, Professor Jayashankar Telangana Agricultural University, Rajendranagar, Telangana, India

Samatha Parameswari Y
Regional Sugarcane and Rice Research Station, Professor Jayashankar Telangana Agricultural University, Rudrur, Telangana, India

Vijayalakshmi D
AICRP on Agroforestry, Professor Jayashankar Telangana Agricultural University, Rajendranagar, Telangana, India

Corresponding Author:
Sravani B
Department of Agronomy, College of Agriculture, Professor Jayashankar Telangana Agricultural University, Rajendranagar, Telangana, India

Effect of irrigation and phosphorus levels on growth and yield of *Rabi* groundnut (*Arachis hypogaea* L.)

Sravani B, Sridhar K, Samatha Parameswari Y and Vijayalakshmi D

DOI: https://www.doi.org/10.33545/2618060X.2025.v8.i9k.3851

Abstract
A field study was carried out to study the growth and yield of *Rabi* groundnut (*Arachis hypogaea* L.) as influenced by different irrigation schedules and phosphorus levels at the Regional Agricultural Research Station, Palem, during *Rabi* 2024-25. The experiment was laid out in a split-plot design with three irrigation schedules (IW: CPE ratios of 0.6, 0.8 and 1.0) as main plots and five phosphorus levels (30 kg P_2O_5 ha^{-1}, 40 kg P_2O_5 ha^{-1}, 30 kg P_2O_5 ha^{-1} + seed treatment with PSB @ 30 g kg^{-1} seed, 40 kg P_2O_5 ha^{-1} + seed treatment with PSB @ 30 g kg^{-1} seed and STCR-based P_2O_5 recommendation) as subplots, replicated thrice. Among irrigation schedules, IW: CPE ratio of 1.0 recorded significantly higher plant height, dry matter production, pod yield (2473 kg ha^{-1}) and kernel yield (1604 kg ha^{-1}) and was on par with IW: CPE ratio of 0.8. Among phosphorus levels, application of 40 kg P_2O_5 ha^{-1} + PSB @ 30 g kg^{-1} produced significantly higher plant height, leaf area index, dry matter production, pod yield (2624 kg ha^{-1}) and kernel yield (1711 kg ha^{-1}) and was statistically comparable with 40 kg P_2O_5 ha^{-1} alone. Interaction effects between irrigation schedules and phosphorus levels were not significant for any growth or yield parameter.

Keywords: Groundnut, phosphorus, phosphorus solubilizing bacteria, growth parameters and yield

Introduction
Groundnut (*Arachis hypogaea* L.) is a key oilseed and food-legume crop for both humans and livestock in tropical and subtropical regions (*i.e.*, between 40° N and 40° S) and is also considered as king of vegetable oil seed crops in India which can be grown during rainy, winter and summer seasons. It occupies a predominant position in Indian oilseed economy. Groundnut comprises of 44-56% edible oil and is the fourth largest source of edible oil. Additionally it contains 22-30% high-quality vegetable protein, 20% carbohydrates as well as essential fatty acids, vitamins and minerals necessary for human nutrition (Jain *et al*. 2018) [12]. It is a key source of earnings for small and marginal farmers in developing countries. Groundnut is grown in 120 countries over a total area of 20.4 M.ha.

India has the greatest amount of land (4.99 M.ha) under groundnut production and stands second after China in terms of annual production (7.39 M.T). Of the Indian groundnut produced, 81% is processed for oil, 12% is retained as seed for future crop, 6% is consumed domestically and about 1% is exported (Jain *et al*. 2018) [12].

Irrigation scheduling is an important parameter to increase the yield of the groundnut crop. Saving irrigation water through efficient irrigation scheduling is a way to reduce water consumption in the agriculture sector. Climatological approach based on IW: CPE ratio (*i.e.*, IW-irrigation water, CPE-Cumulative Pan Evaporation) was found to be the most appropriate that integrates all the weather parameters which determines water use by the crop and is found to increase the production by 15-20% (Taha and Gulati., 2001) [27].

Phosphorus is essential for key plant functions like photosynthesis, respiration, energy transfer and cell processes (Dadarwal *et al*., 1997) [6]. However only about 25% of applied phosphorus is available to crops with the rest becoming fixed in the soil especially in acidic conditions (Baby 2002; Ramanathan *et al*. 2004) [2, 21]. Indian soils typically have low to medium phosphorus levels. Certain soil microbes known as Phosphate Solubilizing Microorganisms (PSMs), can release this fixed phosphorus by producing organic acids (Whitelaw *et al*., 1999; Richardson 2001; Halder *et al*., 1990) [29, 24, 10].

These microbes enhance phosphorus uptake, act as biofertilizers, promote plant growth and help to manage soil-borne diseases (Gaur *et al*., 2004; Henri *et al*., 2008) [8, 11].

Materials and Methods

A filefield experiment was conducted to determine the effect of irrigation and phosphorus levels on growth and yield of *Rabi* groundnut (*Arachis hypogaea* L.) during *Rabi* k2024-25 at Regional Agricultural Research Station, Palem. The field is in Southern Telangana Zone and is 478 meters above mean sea level (MSL), 16º 30' 49.98" N latitude and 78º 15' 06.60 E longitude. Recommended dose of fertili Recommended dose of 40 kg N ha^{-1} in the form of urea, 50 kg K_2O ha^{-1} in the form of muriate of potash and P_2O_5 as per the treatments was applied, Gypsum 500 kg ha^{-1} was applied at pegging stage. At the time of sowing, seed treatment was done with Phosphate Solubilizing Bacteria (30g kg^{-1} seed) with 5% jaggery. The seeds were dried in the shade and sown immediately after drying. The groundnut variety used is K-6 sown with a spacing of 22.5 cm x 10 cm.

The experiment was laid out in a split plot design consisting of three schedules of irrigation I_1, IW: CPE ratio of 0.6; I_2, IW: CPE ratio of 0.8 and I_3, IW: CPE ratio of 1.0 and iveP_1, 30 kg P_2O_5 ha^{-1}; P_2, 40 kg P_2O_5 ha^{-1}; P_3, 30 kg P_2O_5 ha^{-1} + seed treatment with PSB @ 30g kg^{-1} seed ; P_4, 40 kg P_2O_5 ha^{-1} + seed treatment with PSB @ 30g kg^{-1} seed; and P_5, STCR based P_2O_5 Recommendation with a total number of fifteen treatments with three replications.

Five random plants were selected from each treatment for recording observations on plant height, dry matter production and leaf area index at 30, 60, 90 DAS and at harvest. At harvest, five representative plants were taken from each plot to record yield attributes like number of pods $plant^{-1}$, number of kernels pod^{-1}, test weight and yield parameters such as pod yield, kernel yield and haulm yield. The harvest index (%) was computed by dividing the kernel yield (kg ha^{-1}) by the total biological yield (kg ha^{-1}).

The data was analyzed statistically using the analysis of variance (ANOVA) technique for split plot design using the procedures as given by Panse and Sukhatme (1985) [20] and Gomez and Gomez (1984) [9]. The results were presented at 5% level of significance (P=0.05). The critical difference (CD) values were calculated for the parameters for which the F-test was significant, to compare the various treatments mean.

Results and Discussion

Effect of irrigation schedules

Growth parameters

The growth parameters like Plant height, leaf area index (LAI) and dry matter production (DMP) of groundnut were significantly influenced by irrigation schedules at 60 and 90 DAS, while differences at 30 DAS and harvest were found to be non-significant (Tables 1-3).

Plant height was not significantly influenced by irrigation schedules at 30 DAS and harvest, while significant differences were observed at 60 and 90 DAS (Table 1). At 60 DAS, the tallest plants were recorded under IW: CPE ratio 1.0 (22.6 cm) which was significantly higher than IW: CPE ratio 0.6 (20.9 cm) but remained on par with IW: CPE ratio 0.8 (21.3 cm). A similar trend was observed at 90 DAS where IW: CPE ratio 1.0 (28.5 cm) registered the highest plant height which is significantly superior to IW: CPE ratio 0.6 (25.6 cm) and on par with IW: CPE ratio 0.8 (27.5 cm). The improvement in plant height with frequent irrigation (IW: CPE ratio 1.0 and 0.8) attributed to better soil moisture availability that promoted cell elongation, leaf expansion and vegetative growth whereas restricted irrigation (IW: CPE ratio 0.6) caused intermittent moisture stress thereby restricting plant height. Similar results were also reported by Naresha *et al*. (2015) [18].

The effect of irrigation schedules on LAI of groundnut is presented in Table 2. At 30 DAS and harvest, differences among irrigation schedules were not significant. However, significant variations were observed at 60 and 90 DAS.

At 60 DAS, the highest LAI was recorded with IW: CPE ratio 1.0 (2.51) which was statistically superior to IW: CPE ratio 0.6 (2.37) and on par with IW: CPE ratio 0.8 (2.43). Similarly, at 90 DAS IW: CPE ratio 1.0 maintained the highest LAI (2.85) which was significantly higher than IW: CPE ratio 0.6 (2.50) and statistically comparable with IW: CPE ratio 0.8 (2.68). At harvest stage, LAI differences among treatments were non-significant.

The improved LAI under frequent irrigations (IW: CPE ratio 1.0 and 0.8) attributed to sustained soil moisture availability, which favours leaf expansion and canopy development thereby enhancing interception of solar radiation. On the other hand, lower irrigation frequency (IW: CPE ratio 0.6) had resulted in transient water stress, restricting leaf expansion. Similar findings were reported by Arif *et al*. (2016) [1] who observed that adequate irrigation improved LAI and crop growth in groundnut.

The effect of irrigation schedules on dry matter production of groundnut is presented in Table 3. Dry matter production of groundnut increased progressively with the growth of crop up to harvest under all irrigation schedules. At harvest, the highest total dry matter production (7046 kg ha^{-1}) was recorded under IW: CPE ratio 1.0, which was significantly superior to IW: CPE ratio 0.6 and on par with IW: CPE 0.8. The increase in DMP under frequent irrigation (IW: CPE ratio 1.0) attributed to improved soil moisture availability that promoted enhanced photosynthesis, better partitioning of assimilates and sustained growth throughout the crop period. These findings are in close agreement with Solanke *et al*. (2021) [26] who reported that closer irrigation intervals significantly enhanced biomass accumulation in groundnut.

Yield attributes

The data on yield attributes of *Rabi* groundnut as influenced by irrigation schedules and phosphorus levels are presented in Table 4.

The number of pods $plant^{-1}$ increased significantly with irrigation scheduling. At IW: CPE ratio 1.0 the crop recorded the highest pod number (35.9) which was on par with IW: CPE ratio 0.8 (34.6) but significantly superior over IW: CPE ratio 0.6 (33.2). This clearly indicates that providing irrigation at closer intervals ensured better pod filling and reduced stress at critical growth stages. However, the number of kernels pod^{-1} (1.9) and test weight (34.8-36.6 g) were not significantly influenced by irrigation schedules indicating that these attributes are more genetically governed and less responsive to irrigation levels. Similar findings were earlier reported by Ranjitha *et al*. (2018) [23] and Chandini *et al*. (2022) [4] who also observed higher pod numbers under optimum irrigation schedules.

Yield

Irrigation schedules significantly influenced pod yield, kernel yield and haulm yield of groundnut (Table 5). The highest pod yield (2473 kg ha^{-1}) was recorded at IW: CPE ratio 1.0 which was significantly superior to IW: CPE ratio 0.6 (2194 kg ha^{-1}) and IW: CPE ratio 0.8 (2292 kg ha^{-1}). Similarly, kernel yield (1604 kg ha^{-1}) and haulm yield (5232 kg ha^{-1}) were also highest with IW: CPE ratio 1.0. This indicates that adequate and frequent irrigation favoured both reproductive and vegetative growth ensuring balanced partitioning of assimilates.

Although harvest index improved slightly with higher irrigation (32.06%) the differences among treatments were statistically non-significant, suggesting that irrigation mainly increased both pod and haulm yield proportionately. These findings are in line with Lokhande *et al*. (2018) [15] and Rojh *et al*. (2021) [25], who reported higher pod and haulm yields under optimum irrigation regimes due to improved soil moisture availability and nutrient uptake.

Effect of Phosphorus Levels

Growth parameters

Phosphorus levels had a significant influence on the growth parameters (plant height, leaf area index and dry matter production) of groundnut except for plant height and LAI at 30 DAS, where differences were non-significant (Tables 1 to 3).

At 60 DAS, the highest plant height (Table 1) was observed with 40 kg P_2O_5 ha^{-1} + PSB (22.6 cm) which was significantly superior to 30 kg P_2O_5 ha^{-1} (20.9 cm) but on par with 40 kg P_2O_5 ha^{-1} (21.9 cm), 30 kg P_2O_5 ha^{-1} + PSB (21.3 cm) and STCR based Recommendation (21.2 cm). At 90 DAS, 40 kg P_2O_5 ha^{-1} + PSB (29.0 cm) registered the maximum plant height, which was significantly higher than 30 kg P_2O_5 ha^{-1} (24.2 cm) and STCR based Recommendation (27.0 cm) but statistically on par with 40 kg P_2O_5 ha^{-1} (28.7 cm). At harvest, significantly taller plants were recorded in 40 kg P_2O_5 ha^{-1} (28.4 cm) and 40 kg P_2O_5 ha^{-1} + PSB (28.4 cm) which were on par with each other but significantly superior to 30 kg P_2O_5 ha^{-1} (24.3 cm), 30 kg P_2O_5 ha^{-1} + PSB (24.4 cm) and STCR based Recommendation (24.3 cm). These findings are in line with the reports of Kumar *et al*. (2019) [13] who observed that phosphorus fertilization along with bio-inoculants improved plant growth and vigour in groundnut.

Phosphorus levels exerted a significant effect on LAI (Table 2) at 60 and 90 DAS, while no significant differences were recorded at 30 DAS and harvest. At 60 DAS, the maximum LAI was obtained with 40 kg P_2O_5 ha^{-1} + PSB (2.55) which was significantly superior to 30 kg P_2O_5 ha^{-1} (2.34) and at par with 40 kg P_2O_5 ha^{-1} (2.44), 30 kg P_2O_5 ha^{-1} + PSB (2.43). At 90 DAS, 40 kg P_2O_5 ha^{-1} + PSB (3.02) again recorded the highest LAI, significantly higher than 30 kg P_2O_5 ha^{-1} (2.38) and statistically on par with 40 kg P_2O_5 ha^{-1} (2.93). The lowest LAI values were observed in 30 kg P_2O_5 ha^{-1} (2.38). Similar positive responses of phosphorus on LAI in groundnut were earlier documented by Dhadge and Satpute (2014) [7] and Nazir *et al*. (2022) [19].

Among phosphorus levels, 40 kg P_2O_5 ha^{-1} + PSB registered the highest (7304 kg ha^{-1}) total DMP (Table 3) which was significantly higher than all other treatments. This superiority could be attributed to the combined effect of adequate P fertilization and PSB inoculation, which enhanced root proliferation, nodulation, and nutrient uptake, thereby improving assimilate production and partitioning to both haulm and pods. Similar beneficial effects of integrated P management in groundnut were reported by Kumar *et al*. (2019) [13] and Vyshnavi *et al*. (2021) [28]. At 90 DAS, 40 kg P_2O_5 ha^{-1} (2927 kg ha^{-1}) and 40 kg P_2O_5 ha^{-1} + PSB (3003 kg ha^{-1}) produced significantly higher DMP compared to 30 kg P_2O_5 ha^{-1} (2678 kg ha^{-1}) and were statistically on par with each other, highlighting the importance of higher P application in maximizing biomass production.

Table 1: Plant height of groundnut as influenced by irrigation schedules and phosphorus levels

Treatments	30 DAS	60 DAS	90 DAS	Harvest
Main plot (Irrigation schedules)				
I_1: IW: CPE of 0.6	15.8	20.9	25.6	25.2
I_2: IW: CPE of 0.8	16.0	21.3	27.5	26.0
I_3: IW: CPE of 1.0	16.5	22.6	28.5	26.7
SEM±	0.2	0.3	0.5	0.4
C.D(P=0.05)	NS	1.3	1.9	NS
Subplot (Phosphorus levels)				
P_1: 30 kg P_2O_5 ha^{-1}	15.5	20.9	24.2	24.3
P_2: 40 kg P_2O_5 ha^{-1}	16.6	21.9	28.7	28.4
P_3 : 30 kg P_2O_5 ha^{-1} + Seed treatment with PSB @ 30g kg^{-1} seed	16.5	21.3	27.0	24.4
P_4 : 40 kg P_2O_5 ha^{-1} + Seed treatment with PSB @ 30g kg^{-1} seed	16.6	22.6	29.0	28.4
P_5 : STCR based P_2O_5 Recommendation	15.5	21.2	27.0	24.3
SEM±	0.4	0.4	0.4	0.4
C.D (P=0.05)	NS	1.1	1.3	1.1
Interaction				
Effect of phosphorus levels with same level of irrigation schedules				
SEM±	0.42	0.45	0.47	1.15
C.D (P=0.05)	NS	NS	NS	NS
Effect of phosphorus levels with different irrigation schedules				
SEM±	0.43	0.74	0.66	0.96
C.D (P=0.05)	NS	NS	NS	NS

Yield attributes

Phosphorus application exerted a significant effect on number of pods $plant^{-1}$ (Table 4). The highest number of pods was recorded with 40 kg P_2O_5 ha^{-1} + PSB (36.4) which was on par with 40 kg P_2O_5 ha^{-1} alone (36.) but significantly superior to the other phosphorus levels. The results highlight the role of adequate phosphorus in improving reproductive efficiency, as it enhances flowering and peg penetration, ultimately increasing pod setting. Similar results were also reported by Kumar *et al*. (2019) [13] and Moinuddin and Saren (2023) [16].

In contrast number of kernels pod^{-1} (1.8-2.0) and test weight (35.0-36.9 g) were not significantly influenced by phosphorus application.

Yield

Phosphorus application exerted a significant effect on yield parameters (Table 5). The highest pod yield (2624 kg ha^{-1}), kernel yield (1711 kg ha^{-1}) and haulm yield (5386 kg ha^{-1}) were obtained with 40 kg P_2O_5 ha^{-1} + PSB which was significantly superior to the other phosphorus levels and was on par with 40 kg P_2O_5 ha^{-1} alone (2399 kg ha^{-1}). This clearly shows the synergistic role of PSB in enhancing phosphorus solubilization and availability, thereby improving yield.

The lowest yield was observed with 30 kg P_2O_5 ha^{-1} which was significantly inferior to 40 kg P_2O_5 ha^{-1} and 40 kg P_2O_5 ha^{-1} + PSB. Harvest index values (30.29-32.71%) were not significantly affected by phosphorus treatments, implying that P application improved both pod and haulm yield simultaneously without altering the partitioning efficiency. Similar positive responses of phosphorus application to pod and kernel yield were reported by Ramya *et al.* (2022) [22] and Vyshnavi *et al.* (2021) [28].

Table 2: Leaf area index of groundnut as influenced by irrigation schedules and phosphorus levels

Treatments	30 DAS	60 DAS	90 DAS	Harvest
Main plot (Irrigation schedules)				
I_1: IW: CPE of 0.6	2.14	2.37	2.50	2.1
I_2: IW: CPE of 0.8	2.11	2.43	2.68	2.1
I_3: IW: CPE of 1.0	2.12	2.51	2.85	2.3
SEM±	0.0	0.0	0.1	0.0
C.D (P=0.05)	NS	0.1	0.2	NS
Subplot (Phosphorus levels)				
P_1 : 30 kg P_2O_5 ha^{-1}	2.18	2.34	2.38	2.1
P_2 : 40 kg P_2O_5 ha^{-1}	2.15	2.44	2.93	2.2
P_3 : 30 kg P_2O_5 ha^{-1} + Seed treatment with PSB @ 30g kg-^{1} seed	2.11	2.43	2.53	2.2
P_4 : 40 kg P_2O_5 ha^{-1} + Seed treatment with PSB @ 30g kg-^{1} seed	2.06	2.55	3.02	2.3
P_5 : STCR based P_2O_5 Recommendation	2.11	2.42	2.52	2.1
SEM±	0.0	0.0	0.1	0.1
C.D (P=0.05)	NS	0.12	0.22	NS
Interaction				
Effect of phosphorus levels with same level of irrigation schedules				
SEM±	0.07	0.07	0.17	0.11
C.D (P=0.05)	NS	NS	NS	NS
Effect of phosphorus levels with different irrigation schedules				
SEM±	0.08	0.07	0.15	0.10
C.D (P=0.05)	NS	NS	NS	NS

Table 3: Dry matter production of groundnut as influenced by irrigation schedules and phosphorus levels

Treatments	30 DAS	60 DAS	90 DAS	Harvest		
				Pod	Haulm	Total
Main plot (Irrigation schedules)						
I_1: IW: CPE of 0.6	840.1	1698	2608.3	2320.6	4159	6480
I_2: IW: CPE of 0.8	824.4	1799	2733.2	2441.2	4408	6849
I_3: IW: CPE of 1.0	834.9	1827	3101.9	2570.8	4475	7046
SEM±	8.3	25.1	46.1	47.1	62.4	88.7
C.D (P=0.05)	NS	98.4	181.1	184.8	245	348
Subplot (Phosphorus levels)						
P_1: 30 kg P_2O_5 ha^{-1}	843.2	1659	2677.6	2119.7	4244	6364
P_2: 40 kg P_2O_5 ha^{-1}	828.4	1807	2926.9	2582.9	4355	6938
P_3 : 30 kg P_2O_5 ha^{-1} + Seed treatment with PSB @ 30g kg-^{1} seed	832.7	1803	2738.0	2405.9	4280	6686
P_4 : 40 kg P_2O_5 ha^{-1} + Seed treatment with PSB @ 30g kg-^{1} seed	845.2	1836	3003.1	2709.9	4594	7304
P_5 : STCR based P_2O_5 Recommendation	816.0	1769	2726.8	2402.8	4263	6666
SEM±	8.4	33.6	69.1	78.9	83.4	112.2
C.D (P=0.05)	NS	98	201.8	230.4	243	327
Interaction						
Effect of phosphorus levels with same level of irrigation schedules						
SEM±	26.9	25.8	101.6	64.3	245.6	269.0
C.D (P=0.05)	NS	NS	NS	NS	NS	NS
Effect of phosphorus levels with different irrigation schedules						
SEM±	18.7	32.9	111.2	111.4	245.6	209.4
C.D (P=0.05)	NS	NS	NS	NS	NS	NS

Interaction effect

The interaction between irrigation schedules and phosphorus levels on growth, yield attributes and yield of groundnut was found to be non-significant. This indicates that the response of groundnut to phosphorus levels remained consistent across different irrigation regimes. Although the interaction effect was statistically non-significant, a positive one was observed where the combination of IW: CPE ratio 1.0 with 40 kg P_2O_5 ha^{-1} + PSB consistently recorded the highest values for growth parameters, yield attributes and yield. This suggests that maintaining optimum irrigation along with higher and biologically enriched phosphorus application creates a synergistic environment that promotes better root development, nutrient uptake and assimilate partitioning thereby enhancing crop performance. These findings are supported by Madhuri *et al.* (2019) [17].

Table 4: Yield attributes of groundnut as influenced by irrigation schedules and phosphorus levels

Treatments	Number of pods plant^{-1}	Number of kernels pod^{-1}	Test weight (100-seed weight), (g)
Main plot (Irrigation schedules)			
I_1: IW: CPE of 0.6	33.2	1.9	34.8
I_2: IW: CPE of 0.8	34.6	1.9	35.0
I_3: IW: CPE of 1.0	35.9	1.9	36.6
SEM±	0.5	0.0	0.4
C.D(P=0.05)	2.0	NS	NS
Subplot (Phosphorus levels)			
P_1: 30 kg P_2O_5 ha^{-1}	33.1	1.8	35.0
P_2: 40 kg P_2O_5 ha^{-1}	36.1	1.9	35.3
P_3: 30 kg P_2O_5 ha^{-1} + Seed treatment with PSB @ 30g kg-^{1} seed	33.7	1.8	35.2
P_4: 40 kg P_2O_5 ha^{-1} + Seed treatment with PSB @ 30g kg-^{1} seed	36.4	2.0	36.9
P_5 : STCR based P_2O_5 Recommendation	33.6	1.8	35.1
SEM±	0.7	0.1	0.5
C.D (P=0.05)	2.0	NS	NS
Interaction			
Effect of phosphorus levels with same level of irrigation schedules			
SEM±	0.87	0.06	0.66
C.D (P=0.05)	NS	NS	NS
Effect of phosphorus levels with different irrigation schedules			
SEM±	0.96	0.11	0.71
C.D (P=0.05)	NS	NS	NS

Table 5: Yield of groundnut as influenced by irrigation schedules and phosphorus levels

Treatments	Pod yield (kg ha^{-1})	Kernel yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	Harvest index (%)
Main plot (Irrigation schedules)				
I_1: IW: CPE of 0.6	2194	1381	4868	30.94
I_2: IW: CPE of 0.8	2292	1473	5022	31.29
I_3: IW: CPE of 1.0	2473	1604	5232	32.06
SEM±	53.0	37.9	68.4	0.75
C.D (P=0.05)	208	149	269	NS
Subplot (Phosphorus levels)				
P_1 : 30 kg P_2O_5 ha^{-1}	2085	1321	4810	30.29
P_2 : 40 kg P_2O_5 ha^{-1}	2399	1551	5226	31.41
P_3 : 30 kg P_2O_5 ha^{-1} + Seed treatment with PSB @ 30g kg-^{1} seed	2299	1463	4925	31.72
P_4 : 40 kg P_2O_5 ha^{-1} + Seed treatment with PSB @ 30g kg-^{1} seed	2624	1711	5386	32.71
P_5 : STCR based P_2O_5 Recommendation	2192	1384	4856	31.00
SEM±	107.1	71.6	98.6	0.96
C.D (P=0.05)	313	209	288	NS
Interaction				
Effect of phosphorus levels with same level of irrigation schedules				
SEM±	123.40	71.20	189.90	1.58
C.D (P=0.05)	NS	NS	NS	NS
Effect of phosphorus levels with different irrigation schedules				
SEM±	136.20	87.50	151.10	1.45
C.D (P=0.05)	NS	NS	NS	NS

Conclusion

It concluded that frequent irrigation at IW: CPE ratio 1.0 enhanced growth, yield attributes and yield of groundnut performing on par with IW: CPE ratio 0.8. Phosphorus application at 40 kg P_2O_5 ha^{-1} + PSB also recorded superior growth and yield comparable to 40 kg P_2O_5 ha^{-1} alone. Thus, combining optimum irrigation (0.8 or 1.0 IW: CPE) with 40 kg P_2O_5 ha^{-1}, especially with PSB inoculation proved most effective for higher productivity and efficient resource use.

References

1. Arif M, Bhunia SR, Verma IM, Khinchi V. Effect of crop geometry and drip irrigation on growth, yield and economics of groundnut (*Arachis hypogaea* L.). Environ Ecol. 2016;34(4):2274-2278.
2. Baby UI. Biofertilizers in tea. Planters Chron. 2002;98:395-396.
3. Bhunia SR, Chauhan RPS, Yadav BS, Bhati AS. Effect of phosphorus, irrigation and Rhizobium on productivity, water use and nutrient uptake in fenugreek (Trigonella foenum-graecum). Indian J Agron. 2006;51(3):239-241.
4. Chandini SK, Lakshmi NV, Rekha MS, Babu MR. Effect of irrigation schedules on growth, yield characters and yield of groundnut varieties. Biol Forum Int J. 2022;14(4):1148-1152.
5. Chaudhary VJ, Patel BJ, Patel KM. Response of summer groundnut (*Arachis hypogaea* L.) to irrigation scheduling and sources of nitrogen under North Gujarat conditions. Trends Biosci. 2015;8(5):1310-1313.
6. Dadarwal K, Yadav KS, Krishnamurthy R. Phosphate solubilization and mobilization through soil microorganisms. In: Biotechnological approaches in soil microorganisms for sustainable crop production; 1997, p. 293-308.
7. Dhadge SM, Satpute NR. Effect of integrated nutrient management on growth, yield and quality of summer

groundnut (*Arachis hypogaea* L.). Int J Agric Sci. 2014;10(1):314-316.
8. Gaur R, Shani N, Kawaljeet BN, Rossi P, Aragno M. Diacetyl phloroglucinol producing Pseudomonas do not influence AM fungi in wheat rhizosphere. Curr Sci. 2004;86(3):453-457.
9. Gomez KA, Gomez AA. Statistical procedures for agricultural research. 2nd Ed. New York: John Wiley & Sons; 1984.
10. Halder AK, Mishra AK, Bhattacharyya P, Chakrabartty PK. Solubilization of rock phosphate by Rhizobium and Bradyrhizobium. J Gen Appl Microbiol. 1990;36(2):81-92.
11. Henri F, Laurette NN, Annette D, John Q, Wolfgang M, Francois-Xavier E, et al. Solubilization of inorganic phosphates and plant growth promotion by strains of Pseudomonas fluorescens isolated from acidic soils of Cameroon. Afr J Microbiol Res. 2008;2(7):171-178.
12. Jain NK, Meena HN, Bhaduri D, Yadav RS. Drip fertigation and irrigation interval effects on growth, productivity, nutrient, and water economy in summer peanut. Commun Soil Sci Plant Anal. 2018;49(19):2406-2417.
13. Kumar R, Singh V. Effect of phosphorus and sulphur using PSB on groundnut (*Arachis hypogaea* L.) in calcareous soils. Int J Curr Microbiol App Sci. 2019;8(10):591-597.
14. Li ST, Zhou JI, Uang HY, Chen XQ, Du CW. Characteristics of fixation and release of phosphorus in three soils. Acta Pedol Sin. 2003;40(6):908-914.
15. Lokhande DC, Jayewar NE, Mundhe AG. Summer groundnut (*Arachis hypogaea* L.) productivity influenced by irrigation scheduling: A climatological approach. Int J Curr Microbiol App Sci. 2018;6:87-91.
16. Moinuddin G, Saren BK. Response of groundnut varieties to phosphorus management and its residual effect on succeeding baby corn. Biol Forum Int. J. 2023;15(4):603-608.
17. Madhuri DT, Bairagya MD, Prasanna AL, Zaman A. Effects of irrigation regime and phosphorus level on yield and yield attributes of summer groundnut (*Arachis hypogaea* L.). Int J Agric Sci. 2019;11(12):8673-8676.
18. Naresha R, Laxminarayana P, Suneetha Devi KB, Sailaja V, Narender J. Growth and yield of *Rabi* groundnut as influenced by irrigation scheduling and phosphogypsum levels. Green Farming. 2015;6(5):1051-1055.
19. Nazir R, Sayedi SA, Zaryal K, Khaleeq K, Godara S, Bamboriya SD, et al. Effects of phosphorus application on bunch and spreading genotypes of groundnut. J Agric Ecol. 2022;14:26-31.
20. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. 4th Ed. New Delhi: Indian Council of Agricultural Research; 1985.
21. Ramanathan S, Natarajan K, Stalin P. Effect of foliar nutrition on grain yield of rice fallow black gram. Madras Agric J. 2004;91(1-3):160-163.
22. Ramya A, Mohana Rao P, Latha M, Prathibha Sree S. Effect of inorganic phosphorus in combination with bio-inoculants on groundnut crop performance. Pharma Innov J. 2022;11(10):742-745.
23. Ranjitha PS, Ramulu V, Jayasree G, Reddy SN. Growth, yield and water use efficiency of groundnut under drip and surface furrow irrigation. Int J Curr Microbiol App Sci. 2018;7(9):1371-1376.
24. Richardson AE. Prospects for using soil microorganisms to improve the acquisition of phosphorous by plants. Aust J Plant Physiol. 2001;28(9):897-906.
25. Rojh MK, Bhunia SR, Shivran H, Bhawariya A, Bawaliya SC, Ramniwas MR. Effect of irrigation levels and intervals on groundnut (*Arachis hypogaea* L.) cultivars under drip system. Int J Plant Soil Sci. 2021;33(6):41-5.
26. Solanke BN, Shinde RH, Lolamwad NS, Kolekar VB. Effect of irrigation regimes and land configurations on growth and yield of summer groundnut (*Arachis hypogaea* L.). Pharma Innov J. 2021;10(11):2920-2923.
27. Taha M, Gulati JML. Influence of irrigation on yield and moisture utilization of groundnut (*Arachis hypogaea* L.). Indian J Agron. 2001;46(3):523-527.
28. Vyshnavi A, Rao PM, Kumari AL, Lakshman K. Impact of phosphorus management along with FYM and bio-inoculants on yield and yield attributes of groundnut. Pharma Innov J. 2021;10(8):393-397.
29. Whitelaw MA, Harden TJ, Helyar KR. Phosphate solubilisation in solution culture by the soil fungus Penicillium radicum. Soil Biol Biochem. 1999;31(5):655-665.