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Effect of Irrigation Schedules on Growth, Yield Characters and Yield of Groundnut varieties

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ABSTRACT: A field experiment was carried out at the Agricultural College farm, Bapatla during the *rabi* season of 2021-22 to investigate the effect of irrigation schedules on groundnut varieties with IW/CPE ratios that are appropriate for a given season under moisture stress conditions. The experiment was designed in a split-plot with three replications which includes three irrigation schedules IW/CPE ratios of 1.0 (M_1), 0.8 (M_2) and 0.6 (M_3) as main plots, four groundnut varieties *i.e.*, TAG-24 (V_1), Dheeraj (V_2), Kadiri Leapskhi (V_3) and Kadiri Chitravati (V_4) as sub-plots. The results showed that an IW/CPE ratio of 1.0 produced significantly higher yield characters such as number of pods plant^{-1} (24.7), number of filled pods plant^{-1} (22.6), number of branches plant^{-1} (10.5) and test weight (42.3 g). Dheeraj had significantly taller plants (43.3 cm), whereas Kadiri Lepakshi had more branches plant^{-1} (12.7) and drymatter production (8632 kg ha^{-1}) than Kadiri Chitravati, Dheeraj and TAG-24. IW/CPE ratio of 1.0 along with Kadiri Lepakshi out performed Kadiri Chitravati, Dheeraj, and TAG-24 in terms of pod and haulm yield.

Keywords: Irrigation schedules, Groundnut varieties, IW/CPE.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is a globally important oilseed crop contributing 50% of global production with 30% (India) and 20% (China) respectively in the semi-arid tropics (SATs). In India, Groundnut is the king of oilseed crops, containing 47-53 per cent oil, 26 per cent protein, and 11.5 per cent starch (Naresha *et al*., 2018). It accounts for 45 percent of total oilseed area and 60 percent of total oilseed production and grown in three seasons: rainy (85 percent), post-rainy (10 percent), and summer (5 percent) (Lokhande *et al*., 2018). It is grown on 4.9 million hectares and yields 9.25 million tonnes per year, with an average productivity of 1893 kg ha^{-1}. (FAOSTAT, 2020-21). In India, Gujarat is the leading producer accounting for 43% of total output, followed by Rajasthan (13.76%), Andhra Pradesh (12.28%), Tamil Nadu (10.55%), and Karnataka (5.14%).

In Andhra Pradesh, Groundnut was grown in an area of 1.01 million hectares, yielding 0.60 million tonnes at a productivity of 1497 kg ha^{-1} (Ministry of Agriculture and Farmers Welfare, 2020-2021). Low groundnut productivity is mostly occurs due to rainfed conditions, lack of suitable varieties that are appropriate for a season. Drought stress has an adverse influence on the water relations, metabolism, growth and yield of groundnut (Sanjoy *et al*., 2021). A necessary component in the development of crops, irrigation water is expensive and shortage in supply. So, it is crucial to use this input effectively, which can be done by using smart water management techniques. In Groundnut higher yields mainly depends on a timely, adequate water supply. Groundnut output would be increased by increasing watering frequency while maintaining a constant irrigation water total (Giri *et al*., 2017).

Various strategies had been proposed based on different soil types, seasons for scheduling of irrigation in groundnut crops. The primary factor in determining a crop's water requirement is now evaporative demand from the atmosphere and scheduling of irrigation for groundnut crops based on a climatological approach, IW/CPE ratio (Irrigation Water: Cumulative Pan Evaporation) has been found to be the most suitable option at the moment. This method includes all the weather factors that affect how much water the crop uses and is anticipated to boost output by at least 15% to 20%. Irrigation that was timed perfectly increased pod yield and water use efficiency (Taha and Gulati 2001). For peanut productivity and agronomic characteristics, moisture stress throughout the blooming and pod-filling stages is crucial. Magnitude of reduction in the crop yield depends upon groundnut variety. Under moisture stress, both the yield of groundnuts and the quality of the produced goods decline (Shinde *et al.*, 2010). Drought resistant cultivars will be able to produce higher yields under drought stress conditions. Selecting resistant groundnut varieties under moisture stress conditions requires screening (Sunitha *et al*., 2015). Therefore, the current study was conducted to evaluate the impact of irrigation schedules on the growth, yield-attributing traits and yield of different groundnut types.

MATERIALS AND METHODS

The field experiment was held at the Agricultural College farm, Bapatla during the *rabi* season of 2021-22. The soils of the experimental site belongs to sandy loam soil which was neutral in reaction, low in available nitrogen, organic carbon, high in available phosphorous and medium in available potassium. During the crop growth period, total amount of rainfall received was 374.7 mm in 21 rainy days. The experiment was designed in split plot design with three replications. The main plots included three irrigation schedules: M_1- IW/CPE ratio of 1.0, M_2- IW/CPE ratio of 0.8 and M_3-IW/CPE ratio of 0.6, as well as four groundnut varieties: V_1- TAG-24, V_2-Dheeraj, V_3-Kadiri Lepakshi, and V_4-Kadiri Chitravatiin subplots. Irrigation scheduling was done based on climatological approach (IW/CPE). The open pan evaporimeter was used to record daily pan evaporation. In M_1, M_2 and M_3 irrigation schedules, the total amount of water applied to the crop was 410 mm, 340 mm, and 300 mm, respectively. In each treatment, the irrigation depth was kept constant at 50 mm per irrigation. A measured amount of water was given to each treatment through Parshall flume with a capacity of 1cusec (Parshall, 1950). The formula is used to calculate the volume of water to be administered for each treatment.

Volume = Area × Depth

The calculated volume of water from the formula *i.e.*, 900 L was applied for the depth *i.e.*, 50 mm respectively, as per the treatments based on time (minutes) that obtained from discharge rate of the flume. The following calculation was used to calculate the amount of time needed to irrigate the plot.

Time required (min) =

$$\frac{\text{Plot size (m}^2) \times \text{Depth of irrigation (m)} \times 60 \times 1000}{\text{Discharge from parshall flume (l sec}^{-1})}$$

Plant height, number of branches per plant and drymatter production were collected at an interval of 30 days during the growth season, whereas yield characteristics were calculated when the crop was harvested. Data were statistically evaluated for estimation of analysis of variance (Panse and Sukhatme 1985).

RESULTS AND DISCUSSION

Growth Parameters. The information in Table 1 related to groundnut varieties growth properties as influenced by irrigation schedules. The maximum drymatter production was observed at IW/CPE ratio of 1.0, which was significantly superior to 0.8 and 0.6. Growth parameters, namely plant height and number of branches plant^{-1} of groundnut varieties were recorded higher with irrigation scheduled at IW/CPE ratio of 1.0 which was significantly superior over IW/CPE ratio of 0.6 but found on a par with IW/CPE ratio of 0.8. This might be because maintaining appropriate moisture under an IW/CPE ratio of 1.0 boosted nutrient mobility and higher water uptake under a higher irrigation regime which in turn increased photosynthetic activity and raised the dry weight of plants. When compared to M_2 and M_3, M_1 regime produced more drymatter due to higher plant height at all stages. This was evident from the findings of Thaman *et al*. (2001); Padmalatha *et al*. (2002).

In comparison to the other varieties, Dheeraj variety recorded taller plant than that of Kadiri Chitravati, TAG-24 and Kadiri Lepakshi. Statistically, Kadiri Chitravati and TAG-24 were determined to be on par with each another, but Kadiri Lepakshi variety had the maximum number of branches plant^{-1} above Kadiri Chitravati, Dheeraj and TAG-24. Although Kadiri Chitravati and Dheeraj produced equivalent amounts of drymatter, Kadiri Lepakshi produced the highest drymatter compared to the rest of the treatments. This may be because various groundnut genotypes have different growth patterns because of genetic variances. Identical behavior of varieties in respect of growth parameters was also reported by Mouri *et al*. (2018); Raagavalli *et al*. (2019).

Yield Attributes. Data pertaining to yield attributes of groundnut varieties as influenced by irrigation schedules was presented in Table 2. Yield attributes *viz*., number of pods plant^{-1}, number of filled pods plant^{-1} and 100 kernel weight (g) of groundnut varieties were recorded higher at M_1 (IW/CPE 1.0) which was significantly superior over IW/CPE ratio of 0.6 but found on a par with IW/CPE ratio of 0.8. The lowest yield attributes were recorded from IW/CPE ratio of 0.6. Frequent irrigations in M_1 treatment might have created favourable moisture conditions for the crop growth and consequently increased the number of pods plant^{-1}, number of filled pods plant^{-1} and 100 kernel weight (g) than rest of the treatments (M_2 and M_3). These results are in close conformity with the findings of Shaikh *et al*. (2004); Patel *et al*. (2009) and Chaudhary *et al*. (2015).

Kadiri Lepakshi variety was recorded the highest number of pods plant^{-1} and number of filled pods plant^{-1} which was distinctly superior over Kadiri Chitravtai, Dheeraj and TAG-24 whereas the lowest yield attributes were recorded with TAG-24. Sensitivity of TAG-24 to moisture stress might have lead to less number of filled pods than varieties. Similar results were also reported by Behera *et al*. (2015).

Yield of Groundnut

Pod yield (kg ha^{-1}). Among the irrigation schedules, higher pod yield (3175 kg ha^{-1}) (Table 3) was obtained with IW/CPE ratio of 1.0 (M_1) which was significantly superior to that of IW/CPE ratio of 0.6 (2579 kg ha^{-1}) and comparable to IW/CPE ratio of 0.8 (M_2) (2916 kg ha^{-1}). This is probable because there was higher soil moisture availability throughout the crop growth phase, which significantly increased the yield attributes and ultimately the pod yield. Similar findings were reported by Suresh *et al*. (2013); Debasree and Gunri (2014). Among the varieties, highest pod yield (3607 kg ha^{-1})

was recorded with Kadiri Lepakshi which was significantly superior over Kadiri Chitravati, Dheeraj and TAG-24. It might be due to increased growth parameters like number of branches and biomass production which are in consonance with Mohite *et al*. (2017) and Naik *et al*. (2018).

Haulm yield (kg ha^{-1}). The data (Table 3) revealed that irrigation scheduled at IW/CPE ratio of 1.0 (4291 kg ha^{-1}) recorded higher value of haulm yield, which was significantly superior over IW/CPE ratio of 0.6 (M_3) (3681kg ha^{-1}) but found statistically on a par with IW/CPE ratio of 0.8 (M_2) (4034 kg ha^{-1}). However, the lowest haulm yield was recorded with IW/CPE ratio of 0.6. This may be attributed to the maintenance of adequate soil moisture availability in the root zone during key growth stages of the crop. This would have aided in proper nutrient uptake and utilisation, had a positive effect on growth as well as yield components, resulting in a higher overall yield of the crop. Similar results were also reported by Bandyopadhyay *et al*. (2005) and Chitodkar *et al*. (2006).

Among the cultivars, Kadiri Lepakshi out performed Kadiri Chitravati, Dheeraj, and TAG-24 in terms of haulm yield. Dheeraj and Kadiri Chitravati, however, were comparable to one another. In addition to environmental factors, the genotype's genetic makeup may have a role in the highest haulm yield produced by Kadiri Lepakshi. The results revealed in the present study are in confirm with the findings of Meena *et al*. (2015).

Table 1: Plant height (cm), number of branches plant^{-1} and drymatter accumulation (kg ha^{-1}) of groundnut varieties as influenced by irrigation schedules.

Treatments	Plant height (cm)	Number of branches plant^{-1}	Drymatter production (kg ha^{-1})
Irrigation Schedules (M)			
M_1: IW/CPE ratio of 1.0	40.1	10.5	8141
M_2: IW/CPE ratio of 0.8	37.1	9.0	7550
M_3: IW/CPE ratio of 0.6	31.9	8.5	6793
SEm ±	0.89	0.40	123.6
CD (p=0.05)	3.5	1.6	486
CV (%)	8.5	15.0	5.7
Groundnut Varieties (V)			
V_1 : TAG-24	34.8	7.0	6264
V_2: Dheeraj	43.3	8.1	7328
V_3: Kadiri Lepakshi	30.0	12.7	8632
V_4: Kadiri Chitravati	37.3	9.6	7753
SEm±	0.53	0.43	157.15
CD(p=0.05)	1.6	1.3	467
CV (%)	4.3	13.8	6.3
Interaction (M × V)	NS	NS	NS

Table 2: Number of pods plant^{-1}, number of filled pods plant^{-1} and 100 kernel weight (g) of groundnut varieties as influenced by irrigation schedules.

Treatments	Number of pods plant^{-1}	Number of filled pods plant^{-1}	100 kernel weight (g)
Irrigation Schedules (M)			
M_1: IW/CPE ratio of 1.0	24.7	22.6	42.3
M_2: IW/CPE ratio of 0.8	23.0	20.9	41.6
M_3: IW/CPE ratio of 0.6	19.9	17.8	36.7
SEm ±	0.56	0.47	0.67
CD (p=0.05)	2.2	1.8	2.6
CV (%)	8.7	7.9	5.8
Groundnut Varieties (V)			
V_1 : TAG-24	18.9	15.4	33.3
V_2: Dheeraj	20.8	18.3	40.9
V_3: Kadiri Lepakshi	26.9	25.9	41.7
V_4: Kadiri Chitravati	23.4	22.0	44.9
SEm±	0.80	0.60	0.58
CD(p=0.05)	2.4	1.8	1.7
CV (%)	10.6	8.8	4.3
INTERACTION (M × V)	NS	NS	NS

Table 3: Pod yield and haulm yield (kg ha^{-1}) of groundnut varieties as influenced by irrigation schedules.

Treatments	Pod yield (kg ha^{-1})	Haulm yield (kg ha^{-1})
Irrigation Schedules (M)		
M_1: IW/CPE ratio of 1.0	3175	4291
M_2: IW/CPE ratio of 0.8	2916	4034
M_3 : IW/CPE ratio of 0.6	2579	3681
SEm ±	84.8	74.5
CD (p=0.05)	333	293
CV (%)	10.2	6.5
Groundnut Varieties (V)		
V_1 : TAG-24	2074	3424
V_2: Dheeraj	2694	3835
V_3: Kadiri Lepakshi	3607	4647
V_4: Kadiri Chitravati	3185	4101
SEm±	110.3	122.2
CD(p=0.05)	328	363
CV (%)	11.5	9.2
INTERACTION (M × V)	NS	NS

CONCLUSION

According to the findings of the current study, groundnut yield parameters (number of pods plant^{-1}, number of filled pods plant^{-1}, and test weight) and plant growth were considerably higher at IW/CPE ratio of 1.0 (M_1) than with an IW/CPE ratio of 0.8, except drymatter. Among the varieties, Kadiri Lepakshihad greatly increased the number of branches plant^{-1}, dry matter compared to other varieties. Scheduling of irrigations at pre sowing, pegging, pod formation stage and pod development stage (4 irrigations) using IW/CPE ratio of 1.0 resulted in higher pod yield (3175 kg ha^{-1}) which was comparable to that of irrigation scheduled at IW/CPE ratio of 0.8 (2916 kg ha^{-1}) *i.e.*, three irrigations (pre sowing, pegging and pod formation stage) on sandy loam soils under moisture stress conditions with less difference of B:C ratio to that of four (4) irrigations.

FUTURE SCOPE

Conclusion drawn based on the one season data only which require long term research in this lines has to be continued for few more years to determine the suitable groundnut varieties under moisture stress conditions in the coastal zone of Andhra Pradesh.

Conflict of Interest. None.

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