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RESPONSE OF GROWTH AND YIELD OF SUMMER GROUNDNUT (*ARACHIS HYPOGAEA* L.) TO IRRIGATION SCHEDULING AND ANTITRANSPIRANTS

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ABSTRACT

A field experiment was conducted during summer season of 2022 on loamy sand of Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat to study the response of growth and yield of summer groundnut (*Arachis hypogaea* L.) to irrigation scheduling and antitranspirants. The soil was normal in EC, low in organic carbon, available nitrogen, medium in available phosphorus and available potash with slightly alkaline in reaction. The experiment was laid out in split plot design with four replications. Nine treatment combinations consisting three levels of irrigation (0.6, 0.8 and 1.0 IW/CPE) and three antitranspirants (water, kaolin @ 5% and PMA @ 0.032% at 45 and 65 DAS) were embedded. The results indicated that significantly higher growth and yield parameters *viz.*, plant height at harvest, number of branches per plant at harvest, total number of pods per plant, number of filled pods per plant, seed index, shelling percentage, pod yield and haulm yield with irrigation scheduled at 1.0 IW/CPE and antitranspirants applied as kaolin @ 5%. The 0.8 IW/CPE and PMA being at par with 1.0 IW/CPE and kaolin, respectively. Thus, it is concluded that groundnut should be irrigated with 50 mm depth of irrigation at 0.8 IW/CPE and foliar spray of either kaolin @ 5% or PMA @ 0.032% at 45 and 65 DAS to obtain higher growth and yield of summer groundnut.

Key words : Antitranspirants, IW/CPE, PMA, Summer Groundnut, Water Management, Kaolin.

Introduction

Oilseed crops have been the backbone of the agriculture and economy of India from time immemorial. Among the edible oilseed crops, Groundnut accounts for more than 40% of the acreage 60% of production in the country and ranks 1st place in India and 2nd place in production after China (Sridhar *et al*., 2021). Groundnut (*Arachis hypogaea* L.) belongs to family of fabaceae (Leguminosae). The name *Arachis hypogaea* is derived from the Greek word *Arachis* means 'legume' and *hypogaea* means 'below ground'. It is considered as one of the most popular and universal crops cultivated in more than 120 countries. Groundnut is the "King of oilseed crop" also known as 'poor man's almond, earth nut, monkey nut, goober peas, jack nuts, manila nuts and pig nuts (Solaimalai *et al*., 2020). It is one of the most important food, cash crop and one of the most important money-minting legume cum oil seed crops of India and particularly of Gujarat state.

Globally, 29.81 million hectare area and 49.45 million tones production with 16.62 q/ha productivity of groundnut. India is one of the largest exporters in the world and competes closely with Argentina, USA and China by commanding a share of 20-25% in global market. In India, groundnut occupy 6.01 million hectare area and production of 10.24 million tonnes with productivity of 1703.1 kg/ha in 2020-21 (Anonymous, 2022). Gujarat is the leading producer contributing 45.99%

of the total production with an area of 2.07 million hectare and production of 5.46 million tonnes with productivity of 2637 kg/ha (Anonymous, 2020-21) followed by Rajasthan, Tamil Nadu, Andhra Pradesh, Karnataka and Maharashtra.

Irrigation water is becoming scarce and the world is looking for water efficient agriculture. Increasing food demand and declining water resources are challenges for food security (Kreye *et al.,* 2009). Irrigation scheduling is one of the important managerial activities and affects the utilization of water by crops. It determines the process to decide when to irrigate, how to irrigate the crops and how much water to apply. It optimizes agricultural production with minimizing yield loss due to water shortage and improving performance and sustainability of any irrigation system through conserving water. Scheduling irrigation based on evaporative demand results in efficient utilization of water and considerable saving of water.

Antitranspirants can be used under moisture stress conditions and low rainfall areas or drought prone areas. Transpiration can be slowed down as per need by applying Antitranspirants and similar strategies can be adopted for increasing soil water retention capacity. Antitranspirants must be applied at proper stage for enhancement in crop yield. Therefore, antitranspirants are able to mitigate water stress condition and improving crop productivity in the era of climate change (Sow and Shivani, 2021). In the present investigation, an attempt has been made to study the possibility of reducing transpiration losses by foliar application of antitranspirants such as PMA and kaolin without appreciable adverse effect on growth of summer groundnut cv. GJG 32 (Gujarat Junagadh Groundnut 32) grown under different moisture regimes.

Materials and Methods

The experiment was conducted at the Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Agricultural University, Sardarkrushinagar and Gujarat during summer season of the year 2022. It is situated at 24° 19' North latitude and 72° 19' East longitude with an elevation of 154.52 meter above the mean sea level in the North Gujarat Agro-climatic Zone- IV (AES-I).

The soil of experimental field was loamy sand in texture having normal EC (0.12 dS/m), low in organic carbon (0.28%) and available nitrogen (162.8 kg/ha), medium in available phosphorus (39.21 kg/ha) as well as available potash (248.3 kg/ha) with slightly alkaline in reaction. There were nine treatment combinations comprised of three treatments of irrigation scheduling *i.e.*, I_1: 0.6 IW/CPE ratio, I_2: 0.8 IW/CPE ratio and I_3: 1.0 IW/CPE ratio in main plots and three antitranspirants *i.e.*, AT_0: water, AT_1: kaolin 5% and AT_2: PMA 0.032% at 45 and 65 DAS in sub plots was undertaken in split-plot design (SPD) with four replications. Scheduling of irrigation was done as per CPE values calculated *viz.*, 83.4, 62.5 and 50 mm in respective plots. Daily evaporation data was recorded from the USWB open pan evaporimeter installed in agrometeorological observatory. The seeds of groundnut variety Gujarat Junagadh Groundnut 32 (GJG 32) was sown by manually with maintaining 45 cm distance between two rows at a depth of around 5 cm using seed rate of 120 kg/ha with recommended dose of fertilized is 25-50-00 N-P_2O_5-K_2O kg/ha. Gap filling were undertaken at 20 DAS to maintain uniform plant population. The observations related to growth, yield attributes and yield were recorded and subjected to statistical analysis (Gomez and Gomez, 2010).

Results and Discussion

Effect of Irrigation Scheduling

The data clearly showed (Table 1) that different irrigation scheduling remained akin to plant population and had no any significant influence on plant population recorded at 30 DAS as well as at harvest. Consequently, the plant population in all the experimental plots was uniform throughout the plant growth period. This shows that the results obtained in the present investigation was the outcome of treatment effect in the experiment rather than other treatment factors. Irrigation scheduled at 1.0 IW/CPE (I_3) recorded significantly higher plant height at harvest and number of branches per plant, it was statistically at par with treatment I_2 (0.8 IW/CPE). This might be due to more availability of soil moisture when plant needed for its growth. As a result, soil moisture maintained in readily available range might have provided congenial conditions for favourable growth in term of cell division and increase into cell size resulting in expansion of plant in terms of plant height and number of branches/plant.

Yield attributes and yield *viz.*, total number of pod plant/plant (25.18), seed index (40.33 g), selling percentage (68.26%), harvest index (37.11%), pod yield (2128 kg/ha), and haulm yield (3606 kg/ha) were obtained significantly higher under treatment I_3 (1.0 IW/CPE ratio) (Table 2).

The reason for increasing number of pods/plant was frequent water supply and higher amount of water to soil that resulted into increasing uptake of water and provided the longest reproductive phase with larger photosynthetic

Table 1 : Effect of irrigation scheduling and antitranspirants on growth parameters of summer groundnut.

Treatments	Plant population (per metre row length)		Plant height (cm)	Number of branches per plant
	30 DAS	At harvest	At harvest	At harvest
Irrigation scheduling (I)				
I_1 : 0.6 IW/CPE	8.86	8.68	34.86	4.80
I_2 : 0.8 IW/CPE	9.47	8.94	38.16	5.58
I_3 : 1.0 IW/CPE	9.60	9.28	40.30	5.94
S.Em.±	0.26	0.22	1.07	0.18
CD (P=0.05)	NS	NS	3.72	0.62
C.V. %	9.67	8.47	9.85	11.39
Antitranspirants (AT)				
AT_0 : Water spray at 45 and 65 DAS	9.10	8.60	35.66	5.12
AT_1 : Kaolin @ 5% at 45 and 65 DAS	9.44	9.27	38.88	5.74
AT_2 : PMA @ 0.032% at 45 and 65 DAS	9.39	9.03	37.78	5.48
S.Em.±	0.24	0.20	0.89	0.14
CD (P=0.05)	NS	NS	2.65	0.40
Interaction (I × AT)				
S.Em.±	0.42	0.35	1.55	0.24
CD (P=0.05)	NS	NS	NS	NS
C.V.%	9.11	7.72	8.19	8.66

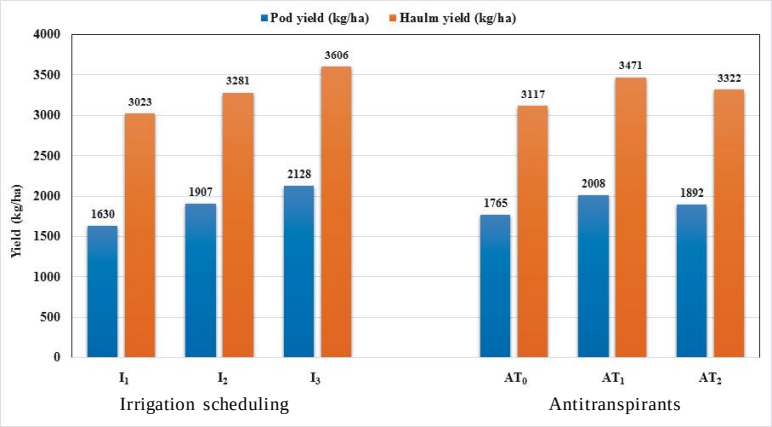

Fig. 1 : Effect of irrigation scheduling and antitranspirants on pod yield and haulm yield of summer groundnut.

green surface and reproductive storage capacity, ultimately that was focus on increase number of pod/ plant. I_1 (0.6 IW/CPE) recorded significantly higher number of unfilled pods per plants (5.78). This is because water stress reduces photosynthesis mainly due to reduction in photosynthetic area and reduce in translocation from source to sink. Treatment I_3 (1.0 IW/ CPE) produced 11.58% and 30.55% higher pod yield over treatment I_2 (0.8 IW/CPE) and treatment I_1 (0.6 IW/ CPE), respectively. Higher pod yield due to the favourable soil water balance (applied water), since water plays a vital role in the carbohydrate metabolism, protein synthesis, cell division, cell enlargement and partitioning of photosynthetic to sink for improved development of growth and yield traits. The findings are in agreement with Swetha and Bhunia (2019), Solanke *et al*. (2021), Chandini *et al*. (2022) and Bhargavi *et al*. (2022).

Effect of antitranspirants

Data presented in Table 1 demonstrate that, Application of different antitranspirants treatments failed to exert their significant effect on plant population at 30 DAS and at harvest. An application of kaolin @ 5% spray at 45 and 65 DAS (AT_1) recorded significantly higher plant height (38.88 cm) at harvest and number of branches (5.74) per plant which was at par with application of PMA 0.032% spray at 45 and 65 DAS (AT_2). This result might be due to branching is related with formation and development of axillary or lateral bud, which physiologically is the function of tissue differentiation, multiplication and development which led to higher accumulation and translocation in plant might have improve vegetative growth and ultimately increased plant height and number of branches per plant in summer groundnut. The results are conformity with the finding of Kadu *et al*. (2017) and El-Shayeb *et al*. (2020).

Table 2 showed significantly higher number of filled pods (19.54), total number of pods (24.92) per plant, seed index (38.62 g), shelling percentage (67.04%), pod yield (2008 kg/ha) and haulm yield (3417 kg/ha) were

Table 2 : Effect of irrigation scheduling and antitranspirants on yield attributes, yield of summer groundnut.

Treatments	Number of pods per plant			Seed index (g)	Shelling percentage (%)	Pod yield (kg/ha)	Haulm yield (kg/ha)	Harvest index (%)
	Filled	Unfilled	Total					
Irrigation scheduling (I)								
I_1 : 0.6 IW/CPE	16.62	5.78	22.40	34.14	63.85	1630	3023	35.03
I_2 : 0.8 IW/CPE	18.78	5.30	24.08	37.85	66.11	1907	3281	36.75
I_3 : 1.0 IW/CPE	20.34	4.84	25.18	40.43	68.26	2128	3606	37.11
S.Em.±	0.64	0.21	0.62	1.13	0.97	75.4	111.8	0.51
CD (P=0.05)	2.23	0.73	2.17	3.90	3.35	260	387	NS
C.V.%	11.99	13.94	9.06	10.42	5.07	13.91	11.72	4.85
Antitranspirants (AT)								
AT_0 : Water spray at 45 and 65 DAS	17.42	5.49	22.91	35.84	64.71	1765	3117	36.15
AT_1 : Kaolin @ 5% at 45 and 65 DAS	19.54	5.38	24.92	38.62	67.04	2008	3471	36.64
AT_2 : PMA @ 0.032% at 45 and 65 DAS	18.80	4.94	23.74	37.96	66.47	1892	3322	36.23
S.Em.±	0.47	0.15	0.46	0.76	0.56	49.67	73.93	0.40
CD (P=0.05)	1.38	0.46	1.35	2.27	1.65	148	220	NS
Interaction (I × AT)								
S.Em.±	0.81	0.27	0.79	1.32	0.96	85.99	128.0	0.69
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS
C.V.%	8.67	10.13	6.59	7.07	2.19	9.11	7.75	3.79

Table 3 : Effect irrigation scheduling and antitranspirants on economics of summer groundnut.

Treatments	Yield (kg/ha)		Income (` /ha)		Gross return (` /ha)	Cost of cultivation (` /ha)	Net return (` /ha)	BCR
	Pod	Haulm	Pod	Haulm				
Treatment combinations (I × AT)								
I_1AT_0	1578	2906	78900	14530	93430	59376	34054	1.57
I_1AT_1	1676	3068	83800	15340	99140	69376	29764	1.43
I_1AT_2	1637	3095	81850	15475	97325	64496	32829	1.51
I_2AT_0	1793	3049	89650	15245	104895	64876	40019	1.62
I_2AT_1	1993	3537	99650	17685	117335	74876	42459	1.57
I_2AT_2	1936	3257	96800	16285	113085	69996	43089	1.62
I_3AT_0	1925	3398	96250	16990	113240	69276	43964	1.63
I_3AT_1	2355	3809	117750	19045	136795	79276	57519	1.73
I_3AT_2	2103	3613	105150	18065	123215	74396	48819	1.66

Selling price of groundnut pod @ 50 ` /kg Selling price of groundnut haulm @ 5 ` /kg.

significantly higher with application of kaolin 5% spray at 45 and 65 DAS (AT_1). It was remained at par with application of PMA 0.032% spray at 45 and 65 DAS (AT_2). AT_1 showed higher pod yield (13.76%) and haulm yield (11.35%) compared to treatment AT_0. Better moisture status of the plant due to kaolin spray resulted in less leaf senescence and higher photosynthesis. These favourable effects could result in better pod development and ultimately in increased pod yield. This higher yield of pod might also be due to increase growth and yield attributing characters. It was further noticed that kaolin spray without any reduction in total water depletion

compared to control, resulted in higher yield attributes and yield. The results confirm with the findings of Kachhadiya *et al*. (2010), Vekariya *et al.* (2020) and Kotadiya *et al.* (2021). Application of water at 45 and 65 DAS (AT_0) noted significantly higher number of unfilled pods (5.49) per plant due to antitranspirants that help to keep the plant's moisture levels more stable. This is important because the development of groundnut pods is sensitive to water stress. When the plant is under water stress, it diverts water away from the developing pods to other parts of the plant, which can lead to the pods not filling properly. Similar results noted by Patil *et al*. (2013) and Singh *et al*. (2010).

Economics

Among the different treatment's combination (Table 3), irrigation scheduled at 1.0 IW/CPE ratio with kaolin @ 5% spray at 45 and 65 DAS (I_3AT_1) registered maximum gross (` 136795/ha) and net reaturn (` 57519/ha) as well as BCR (1.73). The results are conformity might the finding of Dutta *et al*. (2015), Vekariya *et al.* (2020), Kotadiya *et al*. (2021) and Solanke *et al*. (2021).

Interaction Effect

The interaction effect between irrigation applied at different IW/CPE ratios and antitranspirants on growth, yield attributes, pod yield and haulm yield was found non-significant.

Conclusion

In light of the results obtained from this experiment, it is concluded that groundnut should be irrigated with 50 mm depth of irrigation at 0.8 IW/CPE and foliar spray of either kaolin @ 5% or PMA @ 0.032% at 45 and 65 DAS to obtain higher growth, yield, net return and saving of water in loamy sand.

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