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Impact of weather parameters on yield of groundnut (*Arachis hypogaea* L.) under varied environmental condition in Parbhani district of Maharashtra

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Abstract
An experiment entitled 'Impact of weather parameters on yield of Groundnut (*Arachis hypogaea* L.) Under varied environmental condition in Parbhani district of Maharashtra was conducted at research farm of cotton research station, college of agriculture, Parbhani during *summer* season 2018. The field experiment was laid out in split plot design with five replications. there were forty treatments combinations comprising of four date of sowing viz. 3rd SMW, 5th SMW, 7th SMW and 9th SMW as main plot treatment with two irrigation methods as sub plot treatment *viz* T_1 (drip irrigation) and T_2 (furrow irrigation). The gross and net plot sizes were 4.2 x 7.5 m^2 and 3.2 x 6.5 m^2, respectively with spacing of 30 x 10 cm.

The growth parameters like plant height, number of functional leaves, number of branches per plant, dry matter production were significantly influenced by the dates of sowing. The results revealed that groundnut sown in first date of sowing (D_1-3rd SMW) with treatment T_1 (Drip irrigation) is significantly higher growth and yield parameters due to more number of pods, number of grains per pod and 1000 seed weight, followed by D_2 (5-SMW). Among treatment T_1 (drip irrigation) (2017.2 kg/ha) recorded highest grain yield over T_2 (furrow irrigation). The duration of crop growth stages were influenced by the sowing dates.

Keywords: Weather parameters on yield, groundnut, *Arachis hypogaea* L.

Introduction
Groundnut (*Arachis hypogaea* L.) is a annual legume crop and a major oilseed crop of tropical and subtropical countries, which is also known as 'peanut', 'earthnut', 'monkey nut'. It requires a long and warm growing season. The most favorable climatic conditions for groundnut are a well distributed rainfall of at least 500 mm during growing season, it can be very successfully grown in drought prone area during *kharif* season, but during *summer* it required irrigation.

Groundnut is a widely adapted to varying agro-climatic conditions and soils, which has made its cultivation possible in most of the tropical and subtropical countries in the world. Groundnut is a C_3 plant where photo respiration is very high. It has tap root with secondary and deeply spreading roots, make it drought resistant to some extent. Groundnut is a self pollinated crop and pollination takes place early in the morning. The groundnut is mainly grown in *kharif* season, but due to inadequate, uncertain and erratic rainfall distribution coupled with infestation of pest and diseases, production is less. The cultivation of this crop during *summer* is much profitable The Groundnut is a valuable food and oilseed crop. It is commonly called as king of vegetable oilseed crop or poor mans nut. Groundnut seeds (kernels) contains 40-48% fat, 30% protein, 15.5% carbohydrate (Savage *et al.*, 2014) [9]. At the global level 50% of the groundnut produced is use for oil extraction, 37% for confectionary use and 12% for seed purpose. The information on appropriate time of sowing of *summer* groundnut matching with the weather conditions is not available. The present study was to identify the suitable sowing date for better growth and yield of groundnut crop.

Materials and Methods

The experiment was conducted at the research farm of cotton research station, college of agriculture, Parbhani during *summer* season 2018. Soil of the experimental plot was vertisol (Medium black), clayey in texture and having the uniform depth up to 1.20 m. Eight treatment combinations with four dates of sowing (15th January, 25 January, 5 February and 15 February) and one variety (TAG-24), were tried in split plot design with Five replications. The keep date of sowing in main plot and irrigation treatment as sub plot treatments. The crop was sown in line with spacing of 30 x 10 cm, using seed rate of 100 kg/ha with fertilizer dose of 25 kg N and 50 kg P_2O_5 /ha. Full dose of fertilizer in the form of urea and DAP was applied before sowing. Two interculturing and two hand weeding were carried out in groundnut crop to maintain weed free condition during crop season. The five plants from net plot were selected randomly and were tagged in each treatment plots for the purpose of measured observation. The treatments were evaluated on the basis of growth parameters like plant population (plant/m^2) and plant height measured with measuring scale, on the basis of yield attribute like pod yield, test weight and haulm yield measured with weighing balance per net plot and the same was converted to pod yield per hectare. 1000 seeds were counted from the sample and their weight (g) was recorded as test weight of each treatment. Phonological observation measured to decide the crop growth stages five plants from net plot were selected randomly and were tagged in each treatment plots for the purpose of identification of phenological stages. Whenever more than three plants from each plot attained a particular stage for consider for that stage. The same was compared with those from each of the experimental plots to generalize the crop growth stages from each date of sowing were recorded as date of emergence, flowering, pegging, pod development and pod maturity. The recorded data were subjected to statistical analysis.

Results and Discussion

1) Growth Parameters

a) Plant height: The data on plant height recorded at successive stage of groundnut are presented in table 1. It revealed that plant height at different days after sowing was significantly affected by sowing dates. In general, plant height increased with age of the plant thus maximized at harvest stage. Among sowing dates, significantly highest plant height was recorded in D_1 (25.8 cm) followed by D_2 (24.6 cm). However, lowest plant height was recorded in D_4 (23.7 cm) at the time of physiological maturity. Decreased in plant height in late sowing was due to shorter growing period. Among irrigation treatment, significantly highest plant height was obtained by T_1 (drip irrigation) i.e. 25.4 cm followed by T_2 (furrow irrigation) i.e. 23.9 cm. Results are in good agreement with Bhoite *et al.* (1995) [2]. The interaction effect between date of sowing and irrigation treatment was found to be non significant.

b) Number of functional leaves: The mean number of leaves per plant was observed significantly highest in first date of sowing i.e. 3 MW (87.6). Among irrigation treatment numbers of functional leaves were recorded significantly highest in T_1 (Drip irrigation) i.e. 86.1 per plant. The interaction effect between date of sowing and irrigation treatment was found non significant at all stages.

c) Number of branches per plant: The number of branches was observed significantly highest in first date of sowing i.e. 3 MW (9) at harvest than other date of sowing at all stages of crop growth. Lowest number of branches was recorded in 9 MW (6.7) during all growth stages of crop. Among irrigation treatment T_1 (Drip irrigation) recorded significantly highest number of branches than other treatment in all growing stages. The interaction effect between date of sowing and irrigation treatment was found non significant at all stages. These results are in close conformity with the finding reported by Patil *et al.* (2007) [7].

d) Dry matter production: Mean total dry matter accumulation per plant was found to be increased continuously with advancement in age of the crop from 30 DAS till to the maturity stage. The rate of increased in accumulation of total dry matter was slow up to peg formation and increased at faster rate between peg formation to maturity due to the formation of pod and development of kernel. Significantly superior and highest dry matter was observed in sowing 3 MW (25.3 gm) than other date of sowing dates. Among irrigation treatment significantly highest dry matter was observed in T_1 (Drip iirigation) (24.4 gm) at all the growth stages than other treatment T_2 (22.9 gm).

2. Phenological Parameters

a) Number of days required to germination: The mean number of days required to germination was observed that 3 MW require significantly highest days to germination (9 days) while, 9 MW germinated significantly late (7 days) than other date of sowing.

b) Number of days required to anthesis: The differences in number of days require to anthesis was found statistically significant for date of sowing. The D_1 and $T_1$was observed higher number of days to anthesis (33 day for both). Lowest number of days to anthesis was recorded in D_4 (31 days). Present results are in accordance with the results reported Ujinwal (2008) [10].

c) Number of days required for 50 percent flowering: The mean number of days required to 50 percent flowering was observed that 3 MW require significantly highest days to flowering (40 days) while, 9 MW flowered significantly earlier (38 days) than other date of sowing. Similar trend was observed by Sagar kumar (2017) [8]. Among irrigation treatment T_2 flowered significantly earlier (38 days) and highest days require to T_1 (40days).

d) Number of days required to first pod formation: Data presented in Table 5 revealed that the mean number of days for pod formation observed was significantly influenced at different dates of sowing. D_1 (65days) was found to be more days as compare to D_2 (64 days), D_3 (64 days) and D_4 (63 days). Similar results were obtained by Pandey *et al.,* (2001) [6] for *kharif* groundnut. The T_1 (65 days) was recorded more days to attain first pod followed by T_2 (63 days).

e) Number of days required to first seed formation: Perusal of data presented in Table 5 showed that the of days required for first seed formation significantly highest in 3 MW (72 days) followed by 5 MW (71 days), 7 MW (71 days) and 9 MW (70 days). While furrow irrigated treatment seeded significantly earlier (72 days) than other treatment (Drip irrigation).

3. Yield and Yield Attributes

a) Number of developed pods per plant: Among different dates of sowing D_1 (24 pods/plant) showed significantly higher developed pods as compared to D_2 (23pods/plant), D_3 (22plants/plant), D_4 (21 plants/plant). It was seen that T_1 recorded more number of pods per plant (24 plants / plant) thanT_2 (23 pods / plant).

b) Dry pod yield (kg/ha): The data indicated that mean pod yield per hectare of *summer* groundnut was 1993.1 kg/ ha. The data on mean pod yield indicated that among the sowing dates the crop sown in first sowing date 3 MW (15 Jan) recorded significantly highest pod yield (2085 kg/ha) and lowest pod yield was observed in fourth sowing 9 MW (15 Feb) i.e.1895.8 kg/ha. These findings in the present investigation are in accordance with the findings Bhosale *et al*., (1986) [3]. Among the treatment T_1 (2017.2 kg/ha) was recorded significantly superior yield over T_2 (1969 kg/ha). The interaction effect between date of sowing and different irrigation treatment was found to be non significant for pod yield.

c) Shelling percentage (%): The mean shelling percentage was found to be non-significant with various date of sowing. The mean shelling per cent was 71.5. Highest shelling% was observed in D_1 (74.2%) than other sowing dates D_2 (72.9%), D_3 (72.6%), D_4 (71.8%). These results are in close agreement with the findings of Banik *et al*. (2009) [1]. It was found that shelling% at different irrigation treatments found to be non-significant.

d) Test weight (gm): It was observed from data, that the mean test weight of summer groundnut was 40.8 gm per 1000 seeds. The first sowing 3 MW (42.5 gm) showed significantly highest mean thousand seed weight over other date of sowing. The effect of all four sowing date on thousand seed weight was found significant. The treatment T1 (Drip irrigation) found to be significantly superior (41.34 gm) in mean thousand seed weight than other treatment (40.21 gm).

e) Dry haulm yield (kg/ha): It was observed that mean dry haulm yield of groundnut was 407.2 kg/ha. Trend of dry haulm yield was in between 3520 kg/ha to 3255 kg /ha amog all the dates of sowing. D_1 (3520 kg/ha) produced significantly higher mean haulm yield than the D_2 (3486 kg/ha), D_3 (3368 kg/ha). Lowest haulm yield was recorded in D_4 (3255 kg/ha). Results are well studied by Kadam *et al*. (2000) [5]. T_1 (3452 kg/ha) was found significantly higher haulm yield over T_2 (3362 kg/ha) in producing higher haulm yield.

f) Biological yield (kg/ha): The sowing date D_1 recorded maximum biological yield i.e.5605 kg/ha as compared to D_2 (5521 kg/ha), D_3 (5324.5 kg/ha) and D_4 (5151 kg/ha) respectively. Drip irrigation treatment (T_1) was found higher in biological yield i.e.5469.15 kg/ha than other furrow irrigation treatment (T_2) i.e. 5331.5 kg/ha.

g) Harvest index (HI)

The data in Table 7 indicated that the mean harvest index was recorded as 36.16 percent. The harvest index of groundnut was influenced due to different sowing dates. The highest harvest index was recorded in D_1 (37%) over rest of sowing dates. The effect of irrigation treatments i.e. drip and furrow on mean harvest index was found to be non significant.

Table 1: Periodical mean plant height (cm) as influenced by various date of sowing and irrigation treatments

Treatments	Days after sowing						
	30	45	60	75	90	105	At harvest
Sowing dates							
D_1: 3 SMW	11.9	15.2	19.6	20.9	22.7	25.0	25.8
D_2: 5 SMW	10	14.2	17.1	19.5	21.2	23.8	24.6
D_3: 7 SMW	9.8	14.0	16.8	19.5	20.2	21.7	24.6
D_4: 9 SMW	8.9	13.0	16.0	18.6	19.9	20.8	23.7
SE ±	0.20	0.08	0.31	0.16	0.15	0.10	0.15
CD at 5%	0.83	0.34	1.26	0.63	0.61	0.41	0.63
Treatments							
T_1: Drip irrigation	10.55	14.74	18.09	20.37	21.49	23.02	25.41
T_2:Furrow irrigation	9.6	13.5	16.6	18.8	20.5	22.6	23.9
SE ±	0.25	0.29	0.29	0.25	0.32	0.37	0.25
CD at 5%	0.74	0.87	0.85	0.73	0.95	1.11	0.73
Interaction							
SE ±	0.37	0.37	0.47	0.34	0.42	0.47	0.34
CD at 5%	NS	NS	NS	NS	NS	NS	NS
Mean	10.1	14.1	17.3	19.6	21.0	22.8	24.6

Table 2: Periodical mean number of functional leaves/plant as influenced by various date of sowing and irrigation treatments

Sowing dates	Days after sowing						
	30	45	60	75	90	105	At harvest
D_1: 3 SMW	19.3	37.7	58.8	78.8	90.6	89.6	87.6
D_2: 5 SMW	17.7	36.4	57.2	77.0	88.2	87.7	85.8
D_3: 7 SMW	17.6	36.1	56.5	76.8	85.5	84.8	82.9
D_4: 9 SMW	16.8	35.4	52.3	75.5	84.1	83.7	82.1
SE ±	0.23	0.16	0.05	0.25	0.35	0.40	0.29
CD at 5%	0.95	0.66	0.22	1.03	1.43	1.64	1.18
Treatments							
T_1: Drip irrigation	18.5	37.3	57.9	78.1	87.9	87.3	86.1
T_2:Furrow irrigation	17.2	35.6	56.5	76.0	86.2	85.6	84.6

SE ±	0.31	0.33	0.29	0.54	0.44	0.54	0.41
CD at 5%	0.91	0.97	0.87	1.60	1.31	1.60	1.21
Interaction							
SE ±	0.44	0.43	0.36	0.71	0.65	0.78	0.58
CD at 5%	NS	NS	NS	NS	NS	NS	NS
Mean	23.8	36.4	56.5	77.0	87.1	86.4	84.9

Table 3: Periodical mean number of branches/plant as influenced by various date of sowing and irrigation treatments

Treatments	Days after sowing						
	30	45	60	75	90	105	At harvest
sowing Dates							
D_1: 3 SMW	3.9	4.8	5.6	8.1	8.6	8.9	9.0
D_2: 5 SMW	3.3	4.1	5.3	6.3	7.0	7.7	7.6
D_3: 7 SMW	2.9	3.1	5.2	6.4	6.9	7.6	7.7
D_4: 9 SMW	2.4	3.4	4.4	5.4	6.1	6.9	6.9
SE ±	0.08	0.12	0.21	0.20	0.15	0.17	0.15
CD at 5%	0.35	0.51	0.87	0.81	0.63	0.71	0.63
Treatments							
T_1 : Drip irrigation	3.6	4.8	6.1	7.9	7.9	8.5	8.6
T_2 :Furrow irrigation	2.7	3.9	4.6	6.6	6.3	7.0	7.0
SE ±	0.26	0.26	0.28	0.27	0.25	0.23	0.25
CD at 5%	0.76	0.76	0.84	0.80	0.73	0.69	0.73
Interaction							
SE ±	0.33	0.34	0.41	0.39	0.34	0.33	0.34
CD at 5%	NS	NS	NS	NS	NS	NS	NS
Mean	3.1	4.0	5.2	6.8	7.0	7.8	7.8

Table 4: Dry matter accumulation/plant of groundnut (g) as influenced by various date of sowing and irrigation treatments

Sowing dates	Growth stages				
	Germination	Flowering	Peg formation	Pod formation	Maturity
D_1: 3 SMW	1.8	3.5	7.0	18.0	25.3
D_2: 5 SMW	1.6	3.1	5.8	16.8	23.6
D_3: 7 SMW	1.3	2.9	5.7	16.1	22.9
D_4: 9 SMW	0.73	1.9	4.9	15.9	22.6
SE ±	0.06	0.10	0.15	0.16	0.14
CD at 5%	0.26	0.43	0.63	0.65	0.58
Treatments					
T_1: Drip irrigation	1.6	3.2	6.6	17.3	24.4
T_2: Furrow irrigation	1.2	2.6	5.0	16.0	22.9
SE ±	0.15	0.21	0.25	0.25	0.24
CD at 5%	0.46	0.61	0.73	0.75	0.73
Interaction					
SE ±	0.20	0.27	0.34	0.35	0.33
CD at 5%	NS	NS	NS	NS	NS
Mean	1.4	2.9	5.9	16.7	23.7

Table 5: Mean number of days as influenced by various date of sowing and irrigation treatments

Sowing dates	Days req. for germination	Days required for anthesis	Days required for 50% flowering	Days required for first pod formation	Days required for first seed formation
D_1: 3 SMW	9	33	40	65	72
D_2: 5 SMW	8	32	39	64	71
D_3: 7 SMW	7	32	39	64	71
D_4: 9 SMW	7	31	38	63	70
SE ±	0.15	0.12	0.12	0.10	0.15
CD at 5%	0.63	0.49	0.48	0.44	0.63
Treatments					
T_1: Drip irrigation	8	33	40	65	72
T_2:Furrow irrigation	7	31	38	63	70
SE ±	0.25	0.29	0.26	0.28	0.25
CD at 5%	0.73	0.85	0.78	0.83	0.73
Ineraction					
SE ±	0.34	0.37	0.35	0.36	0.34
CD at 5%	NS	NS	NS	NS	NS
Mean	8	32	39	64	71

Table 6: Mean Number of pods/plant, shelling% and test weight (g) as influenced by various date of sowing and irrigation treatments

Treatments	No. of pods/plant	Shelling%	Test weight (g)
Sowing dates			
D_1: 3 SMW	24	74.2	42.5
D_2: 5 SMW	23	72.9	40.7
D_3: 7 SMW	22	72.9	40.5
D_4: 9 SMW	21	71.8	39.3
SE ±	0.29	0.68	0.19
CD at 5%	1.19	NS	NS
Treatments			
T_1: Drip irrigation	23	73.6	41.3
T_2: Furrow irrigation	23	72.2	40.2
SE ±	0.26	0.97	0.31
CD at 5%	0.77	NS	NS
Interaction			
SE ±	0.43	1.37	0.43
CD at 5%	NS	NS	NS
Mean	23.2	72.2	40.8

Table 7: Mean pod yield, haulm yield (kg/ha), biological yield (kg/ha) and harvest index (%) as influenced by various date of sowing and irrigation treatments

Sowing dates	Pod yield (kg/ha)	Haulm yield (kg/ha)	Biological yield (kg/ha)	Harvest index (%)
D_1: 3 SMW	2085	3520	5605	37
D_2: 5 SMW	2035	3486	5521	36
D_3: 7 SMW	1956.5	3368	5324.5	36
D_4: 9 SMW	1895.8	3255	5151	36
SE ±	21.97	33.23	65.24	-
CD at 5%	63.98	96.78	189.98	-
Treatments				
T_1: Drip Irrigation	2017.2	3452	5469.2	36
T_2: Furrow irrigation	1969	3362	5331.5	36
SE ±	15.53	23.50	46.13	-
CD at 5%	21.97	68.43	134.34	-
Interaction				
SE ±	31.07	47	92.27	-
CD at 5%	NS	NS	NS	-
Mean	1993.1	3407.2	5400.4	36.2

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