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Phenological performance of groundnut varieties under sowing environments in hyper arid zone of Rajasthan, India

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Abstract: An experimental trail was conducted on groundnut during *kharif* seasons of 2009 and 2010. The experimental soil was loamy sand in texture. The experiment was laid out in split-plot design with three replications, assigning 32 treatments consisting of four date of sowing (20th April, 15th May, 9th June and 4th July) and two varieties (HNG-10 and TG-37A) as main-plot treatments and four fertility levels of nitrogen and phosphorus application (0, 20 N-40 P_2O_5, 30-60 P_2O_5 and 40 N-80 P_2O_5 kg/ha) as sub-plot treatments. The results showed that significantly higher plant stand was observed in 9th June and 4th July sowing date of the groundnut at harvest. 20th April sowing had significantly higher dry matter accumulation, CGR of 30-60 and 60-90 DAS of HNG-10 variety. Further delays in sowing significantly reduce growth parameters. However, growth parameters *viz.* dry matter accumulation, CGR, RGR *etc.* in all the sowing dates in TG-37A was statistically at par with each other. All the fertility treatments produced significantly higher dry matter, CGR, RGR *etc*. Application of 30 kg N-60 kg P_2O_5 / ha significantly enhanced the dry matter accumulation over 20 kgN-40 kg P_2O_5 /ha but statistically at par with 40 kg N-80 kg P_2O_5/ ha.

Keywords: Date of sowing, Dry matter, Fertility levels, Varieties

INTRODUCTION

In dry land agriculture, farmers have limited choice for sowing time, but in irrigated situation sowing time is one of the most important non- monetary inputs affecting yield of crops. Time of groundnut is well documented in other regions (Sardana and Kandhol, 2007). In Bikaner region, all the cultivation of groundnut is under irrigated conditions. Groundnut cultivation in Bikaner region was started two decades ago in the command area of Indra Gandhi Nahar Pariyojana (IGNP) and later on it spread to tube well irrigated area of the region. At that time, dust storms were common in the region with minimum vegetation during optimum sowing time of May and June months leading to poor crop establishment due to which the farmers started sowing of groundnut in early summer in the months of April and May for better crop establishment with its harvesting in October-November. This practice is still followed, despite reduction in frequency of dust storms in the region. With increase in the irrigated area the practice of early sowing of groundnut in the area despite reduction in the frequency of hot winds is fast depleting the water table in the majority of the blocks (SGWB, 2011) and has considerably reduced WUE (Water use efficiency) of canal command area. Suitable sowing time of groundnut varieties of short and long duration maturity would prove a better strategy of improving WUE and the crop growth. Several workers (Kabadagi and Setty, 2010and Bala *et al.*, 2011) recommended a starter dose of nitrogen until the crop starts nitrogen fixation at about 30 days stage. In the arid region of Rajasthan some workers (Hossain *et al.*, 2007; Pareek and Poonia, 2011) reported 60 kg N /ha along with equal level of phosphorus as the appropriate fertilizer level while others recommended 20 kg N and 32 kg P_2O_5 /ha for groundnut to better crop growth.With these considerations an experiment was conducted on groundnut.

MATERIALS AND METHODS

The field experiment was carried out after survey of Bikaner division of groundnut grower and concluded that 60 per cent farmers sowing groundnut every years in the month of April and irrigated with life saving irrigations up to 33 in IGNP area (DOR, 2009). Experimental trail was conducted during *kharif* season of 2009 and 2010 at Agronomy Research Farm, College of Agriculture, Bikaner (Rajasthan) under hyper arid condition, which is situated at a 28º 01'N latitude and 73 º 22' E longitudes at an altitude of 234.70 meters above mean sea level (*Arabian* Sea). The soil of the

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experimental site was loamy sand and having 156.33 kg/ha alkaline permanganate oxidizable N (Subbiah and Asija, 1956), 16.05 kg/ha available P (Olsen *et al.*, 1954), 221.0 kg/ha 1 N ammonium acetate exchangeable K (Stanford and English, 1949) and 0.80% organic carbon (Jackson, 1973). The pH of soil was 8.4 (1:2.5 soil and water ratio). Field capacity, permanent wilting point and bulk density recorded were 8.4.0% (w/w), 1.1.83% (w/w) and 1.66 Mg/m3, respectively in 0-30 cm soil depth. The experiment was laid out in split-plot design with three replications, assigning 32 treatments consisting of four date of sowing (20 April, 15 May, 9 June and 4 July) and two varieties (HNG 10 and TG 37A) as main plot treatments and four fertility levels of nitrogen and phosphorus application (0, 20 N: 40 P_2O_5, 30 N: 60 P_2O_5 and 40 N: 80 P_2O_5 kg /ha) as sub-plots. All the data obtained from groundnut for two consecutive years of trails were statistically analyzed using the *F*-test (Gomez and Gomez, 1984). Critical difference (CD) values at *P*=0.05 were used for determine the significance of differences between mean values of treatments.

RESULTS AND DISCUSSION

Date of sowing: The results of the study showed that significantly higher crop stand at harvest was observed in 9th June and 4th July sowing than all other sowing dates. This may be due to harsh weather in terms of higher temperature, low relative humidity, low rainfall, higher evaporation and wind velocity in the month of May experienced by the early sown crop (April-May) which lead to poor crop establishment as evident from poor plant stand (Table 1) recorded under these sowing dates. The variety TG-37A recorded significantly higher plant stand at harvest than HNG-10 due primarily to its closer spacing followed in the experiment compared with HNG-10 as evidenced from the difference in the initial plant stand of these varieties at 20.The results also showed that groundnut sown on 20th April recorded significantly higher periodic dry matter production (Table 1) with higher number of nodules at 45 and 60 DAS which progressively decreased with delay in sowing upto the last date of 4th July. The higher dry matter recorded in early sowing could be mainly attributed to the similar crop growth and relative growth rates (Table 2) recorded upto the 90 days stage of the crop. The reversal of growth rates (Crop growth rate and Relative growth Rate) at higher rates recorded with delay in sowing during 90 to 120 days growth phase had narrowed down the reduction in the dry matter production with delay in sowing at 120 days stage. The results of this investigation are in close conformity with the findings of (Reddy *et al.,* 2000; Gosh, 2005; Meena *et al.*, 2014) reported higher values of growth parameters in early sown crop of groundnut with progressive reduction with each delaying in sowing.

Varieties: Results show that of tested varieties in the study, HNG-10 recorded significantly higher periodic dry matter production ranging from 16% at 30 days stage to 45% at 120 days stage than TG-37A primarily due to the differences in the genetic constitution and growth habit of these varieties as evidenced from the similar variation in CGR, RGR *etc.* of these varieties (DOR, 2005; Gochar, 2011). The variable behaviour of these varieties could be explained in genetic constitution and variation in growth habit of these varieties as evidenced from the similar interaction effect recorded on days to maturity of these varieties. HNG-10 is semi-spreading variety which seems to have indeterminate growth habit as evident from the considerable. This variety sown early was exposed to longer duration for vegetative growth due to its indeterminate growth habit and thus recorded higher dry matter production under early sowing. On the other hand, the variety sown on later dates was exposed to shorter duration for vegetative growth and there for recorded less dry matter production at these dates. In contrast, the variety TG-37A is a Spanish bunch type and probably seems to be a variety of short duration maturity and determinate growth habit as evidenced from its almost stable period of maturity under all sowing dates. Thus the variation in growth parameters of the two varieties with variation in sowing dates resulted due to interaction between genetic constitution of the varieties and growth factors like manures, fertilizers, moisture availability vis-a-vis environmental factor like temperature, day length, relative humidity, rainfall, wind velocity and biotic and abiotic factors which have a considerable bearing on important plant functions such as photosynthesis, respiration, transpiration, nutrient and water absorption *etc.* (Sardana *et al.*, 2008; Meena *et al.*, 2013)

Fertility levels: Data on growth parameters of the crop under the influence of fertility levels revealed that various growth parameters were affected by the fertility levels. Growth behaviour of a plant mainly depends on its genetic constitution and prevailing environmental conditions. Growth factors like manures, fertilizers, moisture availability, biotic and a biotic stresses and other environmental factors have a considerable bearing on important plant functions such as photosynthesis, respiration, transpiration, nutrient and water absorption *etc.* From the results of this experiment presented in the preceding chapter, it may be noted that all the fertilizer treatments recorded higher dry matter CGR, RGR *etc.* Application of 30 kg N-60 kg P_2O_5 /ha significantly enhanced the dry matter accumulation over control and the lowest fertilizer level of 20 kg N-40 kg P_2O_5/ ha during both the years. Further increase in fertilizer level upto 40 kg N-80 kg P_2O_5/ ha did not improve there growth parameters significantly over 30 kg N-60 kg P_2O_5/ha for all growth parameters. Application of nitrogen and phosphorus significantly enhanced the plant growth as manifested by increased dry matter accumulation, crop growth rate, initial relative growth rate at all the growth stages. Application of 30 kg N-60 kg P_2O_5 /ha

Table 1. Effect of different growing environments, varieties and fertility levels on plant stand and dry matter accumulation of groundnut.

Treatment	Plant stand (Thousand/ha)						Dry matter accumulation (g/plant)											
	20 DAS			At harvest			30 DAS			60 DAS			90 DAS			120 DAS		
	2009	2010	Pooled	2009	2010	Pooled	2009	2010	Pooled	2009	2010	Pooled	2009	2010	Pooled	2009	2010	Pooled
Date of sowing																		
20th April	292.68	292.13	292.41	225.19	211.77	218.48	5.73	4.48	5.11	31.60	21.55	26.57	89.56	65.95	77.76	100.08	72.56	86.32
15th May	302.76	290.90	296.83	223.08	212.29	217.69	5.34	3.90	4.62	30.18	18.52	24.35	75.34	51.36	63.35	99.55	60.25	79.90
09th June	296.55	296.09	296.32	228.94	229.85	229.40	5.07	4.03	4.55	28.09	20.90	24.49	69.08	53.19	61.13	92.79	66.33	79.56
04th July	301.26	296.65	298.96	232.57	229.97	231.27	4.43	3.74	4.09	25.69	20.80	23.24	61.89	47.42	54.65	82.74	61.59	72.17
CD (*P*=0.05)	NS	NS	NS	4.43	3.81	2.79	0.17	0.16	0.11	1.09	1.15	0.76	4.69	3.97	2.94	3.20	3.14	2.14
Varieties																		
HNG 10	274.57	269.06	271.82	208.01	201.87	204.94	5.72	4.14	4.93	34.88	26.01	30.45	81.56	61.45	71.50	111.57	76.51	94.04
TG37 A	322.05	318.83	320.44	246.88	240.07	243.48	4.57	3.94	4.25	22.90	14.88	18.89	66.37	47.51	56.94	76.01	53.85	64.93
CD (*P*=0.05)	6.03	3.73	3.39	3.14	2.69	1.97	0.12	0.11	0.08	0.77	0.82	0.54	3.32	2.81	2.08	2.26	2.22	1.52
Fertility levels																		
Control	299.40	294.17	296.78	226.60	221.35	223.98	4.87	3.91	4.39	26.11	18.41	22.26	69.19	49.74	59.46	85.53	59.85	72.69
20kgN-40 kg P_2O_5 /ha	297.16	294.32	295.74	227.87	220.95	224.41	5.16	4.02	4.59	28.73	20.45	24.59	74.53	55.07	64.80	93.76	65.12	79.44
30kgN-60 kg P_2O_5 /ha	297.19	293.79	295.49	228.20	221.06	224.63	5.26	4.10	4.68	30.36	21.43	25.89	75.94	56.57	66.26	97.72	67.70	82.71
40kgN-80 kg P_2O_5 /ha	299.50	293.51	296.51	227.12	220.52	223.82	5.28	4.12	4.70	30.36	21.48	25.92	76.21	56.54	66.37	98.16	68.05	83.11
CD (*P*=0.05)	NS	NS	NS	NS	NS	NS	0.13	0.11	0.08	0.98	0.66	0.58	2.86	2.51	1.88	2.98	2.40	1.89

NS- Non significant

Table 2. Effect of different growing environments, varieties and fertility levels on growth parameters of groundnut**.**

Treatment	Crop growth rate (g/plant/day)									Relative growth rate (mg /g/ day)								
	30-60 DAS			60-90 DAS			90-120 DAS			30-60 DAS			60-90 DAS			90-120 DAS		
	2009	2010	Pooled	2009	2010	Pooled	2009	2010	Pooled	2009	2010	Pooled	2009	2010	Pooled	2009	2010	Pooled
Date of sowing																		
20th April	0.86	0.57	0.72	1.93	1.48	1.71	0.35	0.46	0.41	56.01	51.09	53.55	35.15	37.85	36.50	3.63	3.18	3.40
15th May	0.83	0.49	0.66	1.51	1.09	1.30	0.81	0.54	0.67	57.00	50.22	53.61	31.18	35.30	33.24	8.67	5.11	6.89
09th June	0.77	0.56	0.66	1.37	1.08	1.22	0.79	0.68	0.74	56.12	53.18	54.65	30.79	32.56	31.68	9.19	6.93	8.06
04th July	0.71	0.57	0.64	1.21	0.89	1.05	0.70	0.71	0.70	58.43	56.16	57.29	29.29	28.31	28.80	9.79	8.67	9.23
CD (*P*=0.05)	0.03	0.04	0.02	0.14	0.13	0.09	0.12	0.09	0.07	0.97	2.23	1.16	2.00	2.86	1.66	1.79	1.66	1.17
Varieties																		
HNG 10	0.97	0.73	0.85	1.56	1.18	1.37	1.00	1.01	1.01	60.25	61.38	60.82	27.59	28.20	27.89	11.16	7.64	9.40
TG37 A	0.61	0.36	0.49	1.45	1.09	1.27	0.32	0.19	0.25	53.53	43.94	48.74	35.62	38.81	37.21	4.48	4.31	4.39
CD (*P*=0.05)	0.02	0.03	0.02	0.10	0.09	0.06	0.08	0.06	0.05	0.68	1.57	0.82	1.41	2.02	1.18	1.26	1.18	0.82
Fertility levels																		
Control	0.71	0.48	0.60	1.44	1.04	1.24	0.54	0.50	0.52	55.04	49.89	52.46	33.03	34.26	33.64	6.86	6.22	6.54
20kgN-40 kg P_2O_5 /ha	0.79	0.55	0.67	1.53	1.15	1.34	0.64	0.60	0.62	56.53	53.01	54.77	32.21	33.61	32.91	7.38	5.66	6.52
30kgN-60 kg P_2O_5 /ha	0.84	0.58	0.71	1.52	1.17	1.35	0.73	0.64	0.68	58.04	54.15	56.09	30.46	32.88	31.67	8.59	6.01	7.30
40kgN-80 kg P_2O_5 /ha	0.84	0.58	0.71	1.53	1.17	1.35	0.73	0.65	0.69	57.96	53.60	55.78	30.71	33.27	31.99	8.46	6.00	7.23
CD (*P*=0.05)	0.03	0.02	0.02	0.06	0.07	0.05	0.02	0.03	0.02	0.48	1.17	0.62	0.57	1.38	0.74	0.44	0.71	0.41

brought about overall improvement in crop growth under the influence of nitrogen and phosphorus application which could be attributed to better environment for growth and development that might be due to increased availability of these nutrients to the crop plants. This could be supported by the fact that soil of experimental field was very poor in nitrogen and phosphorus. As evident from results, it can be clearly concluded that application of 30 kg N-60 kg P_2O_5 /ha as a basal dose was found adequate for initial pick up of growth, photosynthesis and dry matter accumulation. The results of the present investigation are in agreement with the finding of several researchers (Barik *et al.,* 1994; Ibrahim and Eleiwa, 2008) who also reported increase in the dry matter production, periodic CGR and initial RGR of crop due to basal application of nitrogen and phosphorus. Parasuraman *et al.* (1998) also reported that higher availability of plant nutrients leads to higher growth parameters in the fertilized treatments of groundnut.

Conclusion

On the basis of present study it is recommended for groundnut grower of Bikaner division to grow semi-spreading variety of HNG-10 by planting it around 9th June and fertilizing dose recommended 30 kg N-60 kg P_2O_5 / ha for better growth and higher productivity of groundnut.

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