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HEAT UNIT EFFICIENCY OF GROUNDNUT VARIETIES IN SCATTERED PLANTING WITH VARIOUS FERTILITY LEVELS

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ABSTRACT

A field experiment was conducted during *kharif* seasons of 2009 and 2010 on effect of four growing environments (20th April, 15th May, 9th June and 4th July) and four fertility levels (0, 20 N:40 P_2O_5, 30N:60 P_2O_5 and 40N:80 P_2O_5 kg /ha) on various agronomic traits of two varieties (HNG 10 and TG 37A) of groundnut under semi-arid region of Rajasthan. Semi-spreading variety HNG 10 had yields i.e. pod, kernel, haulm and biological yield were also statistically at par with each other from 20th April to 9th June sowing while days to maturity reduced significantly with delay sowing. Variety TG 37A sown at 4th July had significantly higher yields at 4th July sowing. However, in 9th June sowing had significantly higher heat unit efficiency than all three sowing. Significantly higher yields were recorded in 30 kg N60 kg P_2O_5/ ha which were statistically at par with 40 kg N-80 kg P_2O_5/ ha.

INTRODUCTION

Groundnut shall continue to be an important oil seed crop for the semi- arid regions if the projected demand of oils and fats has to be mat with sustainability. This calls for a considerable growth in production which has to come mainly from the increase in productivity. Of the several factors responsible for its low productivity, proper date of sowing for varieties of different growth habits and efficient nutrient management are considered as major constraint. 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 sowing of groundnut is well documented in other regions (Sardana and Kandhol, 2007). Temperature and light play a key role in influencing crop production. The occurrence of different phenological events during crop growth period in relation to temperature can be estimated by using accumulated heat units or growing degree-days (GDD) (Gouri *et al*., 2005). 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 (SGB, 2011) and has considerably reduced WUE of canal command area. With reduction in the dust storms limiting crop establishment and in order to stabiles the fast depleting water table and improve in the WUE of the crop, determining suitable sowing time of groundnut varieties of short and long duration maturity would prove a batter strategy of improving WUE and the crop productivity. Several workers (Kabadagi *et al.,* 2010; 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 (Pareek and Poonia, 2011; Hossain *et al*., 2007) 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. Due to the variation in the optimum fertilizer requirement for groundnut reported by research workers it has also become necessary to determine fertilizer requirement for the crop varieties of different maturity under different sowing time. Therefore, an experiment was conducted to investigate on heat unit efficiency of groundnut varieties in scattered planting with various fertility levels.

MATARIALS AND METHODS

Field experiments were conducted during *kharif* seasons of 2009 and 2010 at Agronomy Farm, College of Agriculture, Bikaner (Rajasthan) under semi-arid conditions. The soil of the experimental site was loamy sand in texture containing 156.33, 16.05 and 221 kg/ ha available nitrogen, phosphorus and potassium, respectively in 0-30 cm soil depth with pH 8.40 and 0.08 per cent organic carbon content. 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, 20N:40P_2O_5, 30N:60P_2O_5 and 40N:80P_2O_5 kg /ha) as sub plot treatments. Nitrogen and phosphorus were applied as per treatment through urea and SSP basally in the furrows just before sowing at a depth of 8-10 cm by "*pora*" method. Row spacing of HNG 10 and TG 37A was 25 cm and 30 cm with 5 cm depth. In addition to rainfall received during the crop season 17 irrigations in HNG 10 and 12 irrigations in TG 37A were given in early sowing through sprinkler system from time to time to ensure optimum growth, development and yield of groundnut. Hand weeding was done manually with the help of hand hoe to keep the field weed free. At the time of second weeding earthing up along the rows was also done for improvement in pegging. In case of HNG 10 delayed sowing of this variety from 20th April to 4th July reduction in harvesting time while TG 37A all sowing dates took similar harvesting time. The agro climatic parameter growing degree-days and heat use efficiency were worked out. Growing degree-days (GDD) were determined as per Nuttonson (1955).

RESULTS AND DISCUSSION

Effect of sowing dates and varieties

Dates of sowing had significant effects with crop varieties on pod, kernel, haulm and biological yields of groundnut [Table 1 and 2]. The variety HNG 10 recorded higher and almost similar pod and kernel yields under the first three sowing dates beginning from 20th April to 9th June. Delayed sowing of this variety beyond 9th June resulted in significant reduction in these yields. On the contrary variety TG 37A recorded the lowest yields under the early sowing date of 20th April and enhanced these yields considerably with every delay in sowing and recorded the highest pod and kernel yields at the last sowing date of 4th July. These results of this study could be ascribed to the interaction effect of the genetic constitution of these varieties with the variation in environmental factors as offered by different sowing dates (Sardana and Kandhola, 2007). On the contrary, the spanish bunch variety TG 37A seem to be of determinate growth habit recorded the lowest mean yield of 21.70 q/ ha under the sowing date of 20th April. The yields of this variety progressively and significantly increased under later dates of sowing with the highest yield 32.44 q/ ha recorded under the last sowing date of 4th July. Since this is a short duration variety of determinate growth habit, it recorded the highest yields in the last date of sowing as this sowing date provided optimum maturity period requirement to this variety. The early sowing dates provided longer than optimum periods and harsh environments to this variety of determinate growth habit, these dates recorded significantly lower yields. Since the pod and kernel are cumulative function of the yield attributes, the variation in pod and kernel yields of these varieties as affected by sowing dates recoded in this study could be ascribed to the similar variation in the yields as evidenced from [Table 1 and 2]. In HNG 10 recorded higher yields than TG 37A.This may be due to HNG 10 variety produced higher to biomass compared to TG 37A.These results are also agreement with the findings of Gochar (2011); Hariprasanna *et al.* (2008); Canver and Kayanak *et al.* (2010).

Effect of fertility levels

Fertility levels of nitrogen and phosphorus upto 30 kg N-60 kg P_2O_5/ ha significantly increased yields i.e. pod yield, kernel yield, haulm yield and biological yield of groundnut over control and 20 kg N-40 kg P_2O_5/ ha (Table 1). Further increase the fertility level up 40 kg N-80 kg P_2O_5/ ha was statistically at par with 30 kg N-60 kg P_2O_5 ha^{-1}. Days to maturity not affected by fertility levels.Early and plentiful availability of nitrogen and phosphorus to plants favourably influenced the kernel development and kernel size, which ultimately resulted, increased pod and seed index and shelling percentage. Improved overall growth and profuse branching due to nitrogen and phosphorus fertilization led to increased net photosynthesis on one hand and greater mobilization of photosynthates towards reproductive structures on the other might have increased the yields significantly result are agreement with those of (Pareek and Poonia, 2011; Hossain *et al.*, 2007).

Heat unit efficiency and days to maturity

Growth and development of groundnut are affected by different uncontrollable environmental conditions. Effect of different planting dates, thermal temperatures (growing degree days, GDD) agronomic traits of two varieties**.** The heat unit efficiency went on increasing from vegetative growth to pod filling and physiological maturity of the crop. Among the dates of sowing, heat use efficiency was found to be higher for 9th June sowing (Table 3 and 4). Sowing date at 9th June recorded significantly

Table 1: Effect of fertility levels and two varieties on yields of groundnut

Treatment	Pod yield (q/ha)			Kernel yield (q/ha)			Haulm yield (q/ha)			Biological yield (q/ ha)		
	2009	2010	Pooled	2009	2010	Pooled	2009	2010	pooled	2009	2010	Pooled
Varieties												
HNG 10	41.17	32.57	36.87	26.33	20.21	23.27	76.13	50.39	63.26	117.30	82.97	100.13
TG37-A	27.34	25.23	26.28	17.96	16.29	17.12	49.96	29.42	39.69	77.29	54.65	65.97
CD (p=0.05)	1.69	1.71	1.15	1.08	1.17	0.76	2.15	1.60	1.28	1.71	2.29	1.36
Fertility levels												
Control	30.42	25.6	28.04	19.04	15.80	17.42	57.24	36.98	47.11	87.66	62.64	75.15
20kgN-40 kg P_2O_5/ha	34.75	29.2	32.00	22.33	18.38	20.35	61.23	38.77	50.00	95.98	68.02	82.00
30kgN-60 kg P_2O_5/ha	36.16	30.9	33.53	23.73	19.68	21.70	65.82	41.48	53.65	101.98	72.38	87.18
40kgN-80 kg P_2O_5/ha	35.67	29.8	32.74	23.47	19.14	21.31	67.89	42.40	55.15	103.56	72.21	87.89
CD (p=0.05)	1.37	1.63	1.05	0.94	1.06	0.70	2.58	1.90	1.58	2.98	2.46	1.91

Table 2: Interaction effect of different growing environments and varieties on yields of groundnut (pooled mean)

Treatment Date of sowing/ varieties	Pod yield (q/ha) pooled HNG10	TG37A	Mean	Kernel yield (q/ha) pooled HNG10	TG37A	Mean	Haulm yield (q/ha) pooled HNG10	TG37A	Mean	Biological yield (q/ ha) pooled HNG 10	TG37A	Mean
20th April	37.73	21.70	29.71	23.65	14.16	18.91	78.30	46.23	62.27	116.03	67.93	91.98
15th May	37.42	24.26	30.84	23.46	15.78	19.62	65.63	41.01	53.32	103.05	65.27	84.16
09th June	37.89	26.73	32.31	24.44	17.56	21.00	62.38	36.46	49.42	100.27	63.19	81.73
04th July	34.44	32.44	33.44	21.51	20.99	21.25	46.74	35.06	40.90	81.18	67.51	74.34
Mean	36.87	26.28		23.27	17.12		63.26	39.69		100.13	65.97	
CD (p=0.05)		2.30			1.52			2.56			2.73	

Table 3: Effect of futility levels and two varieties on heat unit efficiency and maturity of groundnut

Treatment	Heat unit efficiency (kg /ha degree/day) Biological yield 2009	2010	Pooled	Pod yield 2009	2010	Pooled	Days to maturity 2009	2010	pooled
Varieties									
HNG 10	3.03	2.20	2.61	1.07	0.87	0.97	157	146	152
TG37-A	2.01	1.46	1.73	0.72	0.68	0.70	119	120	120
CD (p=0.05)	0.05	0.06	0.04	0.05	0.05	0.03	0.23	0.37	0.21
Fertility levels									
Control	2.27	1.66	1.97	0.79	0.69	0.74	138	133	136
20kgN-40 kg P_2O_5 /ha	2.48	1.81	2.15	0.91	0.79	0.85	138	133	136
30kgN-60 kg P_2O_5 /ha	2.64	1.93	2.28	0.95	0.83	0.89	138	133	136
40kgN-80 kg $P_2O_{5/}$ ha	2.68	1.92	2.30	0.93	0.80	0.87	138	133	136
CD (p=0.05)	0.08	0.06	0.05	0.04	0.04	0.03	NS	NS	NS

Table 4: Interaction effect of different growing environments and varieties on heat unit efficiency of yields and days to maturity (pooled mean)

Treatment Date of sowing/varieties	Heat unit efficiency (kg/ha degree/day) Biological yield HNG10	TG37A	Mean	Pod yield HNG10	TG37A	Mean	Days to maturity HNG10	TG37A	Mean
20th April	2.55	1.49	2.02	0.83	0.48	0.65	187.67	120.00	153.83
15th May	2.60	1.65	2.13	0.95	0.61	0.78	162.17	119.63	140.90
09th June	3.04	1.92	2.48	1.15	0.81	0.98	137.50	120.13	128.81
04th July	2.26	1.88	2.07	0.96	0.90	0.93	119.50	119.00	119.25
Mean	2.61	1.73		0.97	0.70		151.71	119.69	
CD (p=0.05)		0.07			0.06			0.42	

higher heat unit efficiency than all other three sowing dates. Significantly higher heat unite efficiency was observed in variety HNG 10 compared to TG 37A. Among the varieties HNG 10 consumed more heat units to reach maturity during all the crop growth seasons (kingra and kaur, 2012).Significantly higher days to maturity was observed in HNG 10 variety compared to TG 37A. The variety HNG 10 being of semi-spreading type, relatively of longer duration and indeterminate growth habit had an optimum maturity duration of 135 to 140 days recorded similar yields under the first three dates with varying maturity periods of 138 to 188 days. The similar yields of this variety recorded under these dates could be attributed to the optimum maturity period available to the crop under the sowing date of 9th June and adjustment of phenological phases as per longer duration of maturity beyond 138 days available under the early sowing dates of 20th April and 15th May due to its indeterminate growth habit. Further delay in sowing of this variety on 4th July provided a considerably lower duration of maturity than optimum and resulted in significant reduction in these yields. The variety HNG 10 being of semi-spreading type, relatively of longer duration and indeterminate growth habit and took for maturity periods up to 188 days while On the contrary, the spanish bunch variety TG 37A seem to be of determinate growth habit recorded and took 120 days for maturity and yields Canver and Kayanak *et al.* (2010)

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