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Yield Attributing Characters and Yield of Groundnut (*Arachis hypogaea* L.) as Influenced by Irrigation Levels and Mulches

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A B S T R A C T

A field experiment was conducted to evaluate the effect of irrigation levels and mulch on yield attributing components and yield of groundnut (*Arachis hypogaea* L.) in study. The treatment comprised of 4 levels of irrigation viz., 0.4, 0.6, 0.8 and 1.0 ETc in the main plot and three mulch viz., no mulch (control), straw mulch and plastic mulch in the sub plot in split plot design. The soil was poor in organic carbon (0.11%), low in available nitrogen content (86.41 kg/ha) and medium in phosphorus (33.4 kg/ha) but high in available potassium (337.0 kg/ha) content and slightly alkaline in reaction (pH 8.4). The groundnut crop was grown by following the recommended package of practices for zone- IC (hyper arid partially irrigated western plain zone). Irrigation level at 1.0 ETc gave higher pods .per plant (44.16), pod yield (3395 kg/ha), kernel yield (2343 kg/ha), haulm yield (5530 kg/ha), biological yield (8925 kg/ha), harvest index (38.04%), seed index (42.60 gram). Plastic mulch recorded highest pods per plant (40.09), pod yield (2973 kg/ha), kernel yield (2052 kg/ha), haulm yield (4870 kg/ha), biological yield (7843 kg/ha), harvest index (37.89 %), seed index (41.31 gram). Pods per plant (44.64) and pod yield (3523 kg/ha) were highest under 1.0 ETc along with plastic mulch.

Introduction

Groundnut (*Arachis hypogaea* L.) is adorned as a king of oilseeds is grown all over the world. Moisture is the key factor of production but mismanage of water like improper scheduling of irrigation, providing excess water to the crop often leads to the reduction in yield as well as water use efficiency also. Agriculture is by far the biggest user of water Accounting for 70 % of the water utilization worldwide and 90 % of water utilization in the developing countries. Major irrigation projects accompanied by unscientific water water management running into serious environmental and social problems. For efficient utilization of water, proper scheduling of irrigation to the crop would be

on the scientific manner. To bring more area under irrigation by using same amount of irrigation water advanced method of irrigation methods like drip irrigation in groundnut crop is essential. For efficient utilization of irrigation water, it is necessary to find out proper scheduling of irrigation. Irrigation scheduling based on climatological approach (ETc) is considered as most scientific approach as it integrates all the weather parameters giving them natural weightage in a given climate-plant continuum (Parihar *et al*., 1976). As the soil and climatic condition are suitable for groundnut cultivation, but due to high potential evapotranspiration and relatively low rainfall in north western region of India, especially the states like Rajasthan it creates a more problem. To mitigate this problem mulching is very important because it prevents direct evaporation of moisture from the soil and thus counteracts the water losses over the soil surface. In this manner it plays positive role in both soil and water conservation.

Materials and Methods

Description of study area

Field experiment was conducted during Kharif 2017 at the Instructional farm, College Of Agriculture, Swami Keshwanand Rajasthan Agriculture University, Bikaner, and Rajasthan, India. Bikaner is situated at 28.01^0N latitude and 73.22^0E longitude at an altitude of 234.70 meters above mean sea level. According to National planning commission, Bikaner falls under Agro climatic zone XIV (Western Dry Region) of India. According to "Agro-ecological region map" brought out by the National Bureau of Soil Survey and Land use planning (NBSS & LUP), Bikaner falls under Agro-ecological region No.2 under arid ecosystem, which is characterized by deep, sandy and coarse and these two are compared with plots without loamy, desert soils with low water holding capacity, hot and arid climate. Annual Potential Evapotranspiration in this region varies between 1500-2000 mm. Bikaner has arid climate with average rainfall of about 250 mm. The soil of the experimental field was loamy san in texture and slightly alkaline in reaction. The soil was poor in organic carbon, low in available nitrogen and medium in phosphorus but high in available potassium.

Experimental design

The experiment was laid out in a split plot design as different irrigation levels in main plots and mulches in sub plots. The twelve treatments, namely, 0.4 ETc irrigation level with no mulch (I_1M_0), straw mulch (I_1M_1), plastic mulch (I_1M_1), 0.6 ETc with no mulch (I_2M_0), straw mulch (I_2M_1), plastic mulch (I_2M_1), 0.8 ETc with no mulch (I_3M_0), straw mulch (I_3M_1), plastic mulch (I_3M_1), and 1.0 ETc with no mulch (I_4M_0), straw mulch (I_4M_1), plastic mulch (I_4M_1) were replicated thrice . The plot size was 4.0 X 5.0 m. The groundnut variety 'HNG-10' was used at 100 kg/ha of seed rate. First irrigation (25 mm) was given immediately after sowing to ensure proper germination and subsequent irrigations were scheduled in alternate days as per treatment through drip system. The quantity of water was calculated as follows:

$$\text{Irrigation water (mm)} = PE \times Kp \times Kc$$

Where,

PE = Pan evaporation (mm)
Kp = Pan factor
Kc = Crop factor

Pan factor (Kp) was selected from FAO irrigation and drainage paper 24 (Crop water requirement). During rainy days the volume of water applied to each treatment was adjusted for effective rainfall received. The crop factor (Kc) for the groundnut crop for different stage is depicted in Table 1. The soil was covered with straw and plastic mulch as per treatment mulch (control).

Sampling and measurements

The pods per plant and kernels per pod were manually recorded by selecting five randomly selected plants in each plot. For seed index a composite sample of kernels from each net plot was drawn from the shelled pods and the 100 kernels were counted and weight in grams and were recorded separately for each net plot by electronic balance. The pod yield, haulm yield and biological yield was recorded plot wise and then converted into kg/ha.

The harvest index was worked out as per formula advocated by Singh and Stoskoff (1971).

$$\text{Harvest Index (\%)} = \frac{\text{Economic Yield (kg/ha)}}{\text{Biological Yield (kg/ha)}} \text{ X } 100$$

The shelling percentage was computed by taking a composite sample of 100 gram from the bulk of the dry pods of each net plot randomly and shelled. The ratio of kernel to pod weight was worked out and expressed in per cent. The data obtained from various characters under study were analyzed in accordance with the "Analysis of variance" technique suggested by Fisher (1950) for split plot design.

Results and Discussion

Effect of irrigation levels on yield attributing characters and yield of groundnut

The data was recorded and analysed for different yield attributing characters and yield of groundnut (Table 2 and 3). In groundnut, the increase in yield proportionatly with the increase in irrigation level upto 1 ETc. Irrigation level 1.0 ETc gave significantly higher pods per plant(44.17 pods), pod yield [3395kg/ha (Figure 1)], kernel yield (2343 kg/ha), haulm yield [5533 kg/ha (Figure 2)], biological yield (8925 kg/ha), harvest index (38.04%) and seed index (42.60 grams) as compared to rest of the irrigation levels. It might be due to the reason that at 0.4 ETc, water availability was meager which caused plant mortality as well as poor growth of plant due to extreme hot climate during summer months which resulted in poor yield. Sripunitha *et al*., (2011) reported that drip irrigation at 100 per cent potential evapotranspiration led to a greater kernel yield and higher kernel quality in groundnut. Number of kernels per pod remains unaffected due to different irrigation levels. However, size of kernel was affected. Larger sized kernel was obtained with full irrigation while smaller (shrink) size obtained with irrigation level at 0.4 ETc. This might have happened due to lower amount of irrigation water supplied to the crop which causes poor growth of crop. Sezen *et al*., (2008) also reported that both irrigation levels and irrigation frequencies had significant effect on seed size in beans.

Effect of mulch on yield attributing characters and yield of groundnut

Plastic mulch significantly influenced yield and yield contributing characters *viz.* pods per plant (40.08), pod yield [2973 kg/ha (Figure 1)], kernel yield (2052 kg/ha), haulm yield [4870 kg/ha Figure 2)], biological yield (7843 ka/ha), seed index and harvest index. However, kernels per pod remained unaffected (Table 2 and 3). The superiority of plastic mulch and straw mulch over no mulch could be due to their effectiveness in reducing the evaporation losses by creating the obstacle in external evaporability by cutting of solar radiation falling on the earth surface. It seems that moderate hydrothermal regimes under mulch materials may have resulted better development.

Table.1 Crop factor for groundnut throughout the crop growth period

Sr. No.	Month and Days	Stages	Crop factor (K_C)
1	June (21-30)	Initial	0.5
2	July (1-10)	Initial	0.5
3	July (11-30)	Crop development	0.8
4	July (31)	Mid	1.1
5	Aug. (1-31)	Mid	1.1
6	Sept. (1-30)	Mid	1.1
7	Oct. (1-24)	Final	0.7

Table.2 Effect of Irrigation levels and mulch on pods per plant, kernels per pod, pod yield, haulm yield and biological yield of groundnut

Treatments	Pods/plant	Kernels/pod	Pod yield (kg/ha)	Kernel yield (kg/ha)	Haulm yield (kg/ha)	Biological yield (kg/ha)
Irrigation levels						
0.4 ETc	29.00	1.98	2025	1391	3442	5467
0.6 ETc	37.00	2.02	2631	1816	4311	6942
0.8 ETc	41.34	2.11	3074	2122	5042	8117
1.0 ETc	44.17	2.13	3395	2343	5530	8925
SEm±	0.24	0.02	24	16	43	66
CD (P=0.05)	0.84	NS	84	56	147	229
Mulching						
No mulch	35.08	2.00	2561	1762	4264	6826
Straw mulch	38.47	2.05	2810	1939	4611	7421
Plastic mulch	40.08	2.13	2973	2052	4870	7843
SEm±	0.11	0.01	5	4	11	16
CD (P=0.05)	0.33	NS	16	12	34	48

Table.3 Effect of irrigation levels and mulch on harvest index, seed index and shelling percentage of groundnut

Treatments	Harvest Index (%)	Shelling percentage (%)	Seed index (gram)
Irrigation levels			
0.4 ETc	36.98	68.79	39.06
0.6 ETc	37.89	68.96	40.45
0.8 ETc	37.88	69.29	41.65
1.0 ETc	38.04	69.39	42.60
SEm±	0.06	0.06	0.14
CD (P=0.05)	0.21	NS	0.47
Mulching			
No mulch	37.40	68.67	40.43
Straw mulch	37.82	69.09	41.08
Plastic mulch	37.89	69.55	41.31
SEm±	0.03	0.07	0.05
CD (P=0.05)	0.10	NS	0.15

SEm± - Standard Error Mean, CD- Critical difference

Table.4 Interaction effect of irrigation levels and mulching on pods per plant and pod yield of groundnut

Treatments	Pods per plant				Pod yield (kg/ha)			
	0.4 ETc	0.6ETc	0.8ETc	1.0ETc	0.4 ETc	0.6ETc	0.8ETc	1.0 ETc
No mulch	25.00	32.00	39.67	43.67	1760	2345	2890	3250
Straw mulch	30.17	38.67	40.87	44.17	2053	2687	3087	3412
Plastic mulch	31.83	40.33	43.50	44.67	2262	2860	3247	3523
SEm±	0.43				21			
CD*(P=0.05)	1.30				62			
SEm±	2.86				79			
CD(P=0.05)**	8.58				236			

CD*- CD for mulching at the same level of irrigation levels,
CD**- CD for irrigation levels at the same or different levels

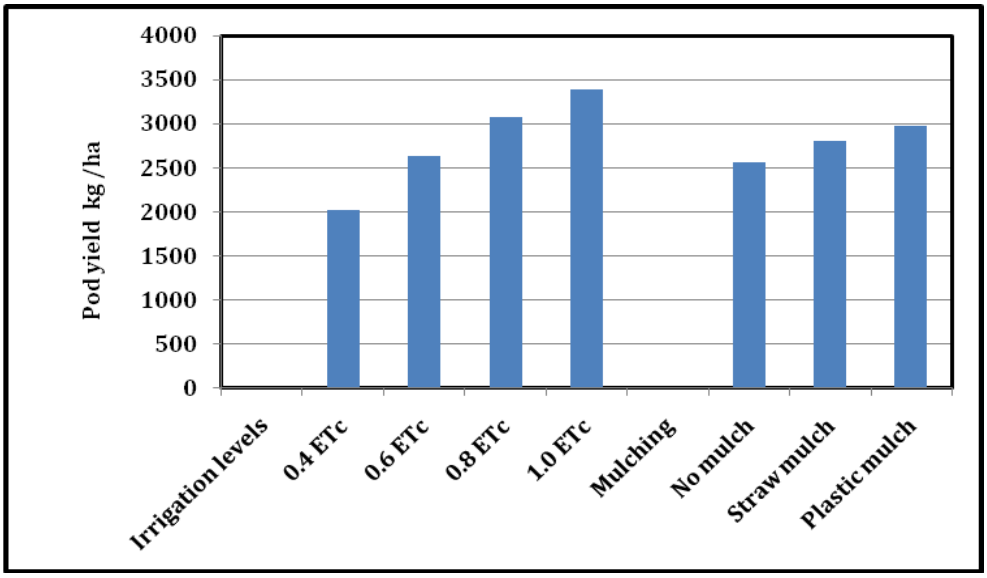

Figure.1 Effect of irrigation levels and mulch on pod yield of groundnut

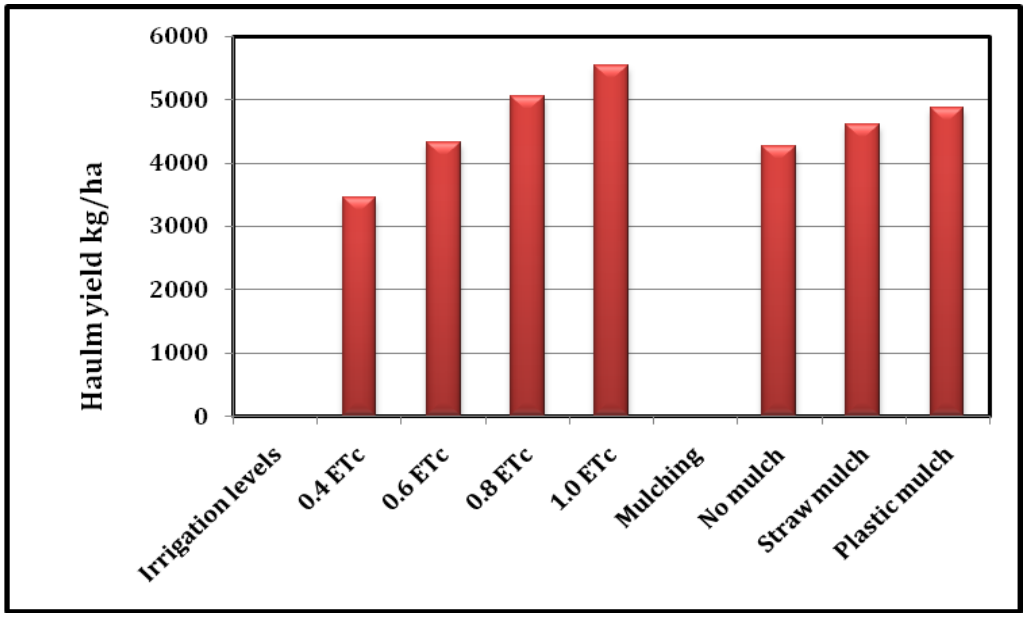

Figure.2 Effect of irrigation levels and mulch on haulm yield of groundnut

Thus, the improvement in yield attributes of groundnut under mulching practices ascribed to better availability of moisture and moderation of soil temperature which led to greater uptake of nutrients and reduced number of days taken to meet required heat unit for proper growth and development of plants and ultimately the yields. The findings of present investigation are closely conformed by the Yadav (2006) in mustard and Eid *et al*., (2013) in soybean.

Interaction effect of irrigation levels and mulch on yield and yield attributing characters of groundnut

The interaction of different irrigation levels with mulches was significant in pods per plant and pod yield (Table 4). Highest pods per plant was recorded under plastic mulch at irrigation level of 1.0 ETc (44.67 pods plant^{-1}), It might be due to maintenance of water regime at nearer to field capacity in soil under irrigation under higher water regime throughout the growing period which enhanced the pod development with mulch at 1.0 ETc irrigation levels. Thus, highest pod yield was recorded under 1.0 ETc irrigation level along with plastic mulch. These results are in line with those reported by maniruzzaman *et al.*, (2007).

From the experimental results it may be inferred that in the prevailing agroclimatic condition, groundnut can yield successfully with irrigation scheduled at 1.0 ETc along with mulch. This combination will produce maximum yield potential of groundnut in areas where rainfall level is less and potential evapotranspiration is more.

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