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EFFECT OF MAIZE AS SHELTERBELT ON YIELD AND WATER USE EFFICIENCY OF IRRIGATED GROUNDNUT

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ABSTRACT

Studies were conducted to find out the possibility of using maize as shelterbelt for irrigated groundnut and effect of crop shelterbelt (Maize) on the canopy weather, yield and WUE of summer groundnut (TMV2) in alfisol. The results indicated that weather around groundnut canopy is considerably altered by the crop shelterbelt. Reduced wind velocity and evaporation coupled with higher relative humidity were recorded in sheltered crop resulting in lower daily water use rate and consumptive use of groundnut. Biomass and pod yields of groundnut were favoured by crop shelterbelt. Pod yield increase of 21 to 24 per cent and consumptive use reduction of 20 per cent was observed in the sheltered treatments compared to unsheltered ones. Water use efficiency was markedly increased by shelterbelt.

KEYWORDS: Shelterbelt, Maize, Groundnut, Water use efficiency, Weather.

With the limited scope for further exploitation of water resources and growing need for diversion of presently used irrigation water to expanding industrial and exploding population, greater urgency for judicious and efficient use of irrigation water is warranted. Climate plays a pivotal role in the alteration of consumptive use of crop through fluctuated atmospheric demand around crop canopy. Shelterbelts are known to maintain cooler crop canopies by reducing wind velocities and thereby restricting evapotranspiration from crop canopy. Tall growing crops and perennial grasses when used as shelterbelts have been reported to conserve moisture and increase the yields of crops like soybean (Radke and Bunows 1970) and wheat (Aase and Siddoway 1974, Frank *et al.* 1977). The effect of crop shelterbelts on yield and water use efficiency (WUE) on groundnut has not been studied. Investigations were therefore undertaken to study the influence of maize as shelterbelt on the crop canopy weather, yield and water use efficiency of irrigated groundnut during summer.

MATERIALS AND METHODS

Field experiment was conducted during summer season of 1978 at Tirupati campus of Andhra Pradesh Agricultural University to study the influence of crop shelterbelt (Maize) on the yield and WUE of irrigated groundnut (TMV 2) on sandy loam soils. The treatments were:

T_1 = Both sides unsheltered (control on SW side)

T_2 = Both sides unsheltered (control on NE side)

T_3 = Unsheltered from SW side winds but sheltered with four double rows of shelterbelt from NE side winds.

T_4 = Sheltered from SW side winds with one double row and from NE side winds with three double rows of shelterbelt.

T_5 = Central plot sheltered from SW and NE side winds with two double rows of shelterbelts on both sides.

T_6 = Sheltered from NE side winds with one double row and from SW side with three double rows of shelterbelts.

T_7 = Unsheltered from NE side winds but sheltered with four double rows of shelterebelts from SW side winds.

The design adopted was completely randomised design with three replications. The gross and net plot size were 120 m^2 and 30 m^2 respectively. Groundnut was sown with a spacing of 25 x 10 cm and manured with 20 N, 13 P_2O_5 and 25 K_2O kg.ha^{-1}. Shelterbelt (Maize) was planted in SE-NE direction which was across to the prevailing winds during cropping season. Maize was sown in quincunx pattern in double rows with 60 x 20 cm spacing, one week prior to groundnut sowing. The length of the shelterbelt was 60 m and distance between two shelterbelt rows was 8 m. Wind velocity was measured with hand cup anemometer at the top of height of shelterbelt in the center of each plot. Relative humidity was measured with Assman psychrometer in the centre of each plot at the top of groundnut canopy. Evaporation was measured from Can Evaporimeters kept at groundnut crop height in the centre of each plot. Consumptive use of water for groundnut crop was obtained by estimating the soil moisture content gravimetrically, before and 24 hours after each irrigation. Mean daily water use was obtained by dividing the crop consumptive use with the crop duration. The WUE was derived as a quotient of pod yield (kg.ha^{-1}) and consumptive use (mm) and expressed as kg.ha mm^{-1}.

RESULTS AND DISCUSSION

Weather in groundnut canopy was altered by shelterbelts. Wind velocity and evaporation were low and relative humidity was high in sheltered treatments compared to unsheltered (Table.1.). Tall grown maize exerted shelterbelt effect by reducing the wind velocity in the groundnut canopy with the result of which relative humidity was maintained at slightly higher level than unsheltered crop. This situation was manifested lower evaporation from sheltered crop to the tune of 0.96 mm.day^{-1}.

Dry matter production (DMP) at harvest and pod yield were significantly influenced by crop shelterbelt (Table.2). Sheltered crop recorded significantly higher biomass and pod yield than unsheltered. The percentage increase in pod yield of groundnut in the sheltered treatments was 21 to 24 over unsheltered ones. Improved performance of groundnut under shelter might be due to effective utilisation of soil moisture throughout the growing period.

Daily water use and consumptive use of groundnut were significantly influenced by sheltering effect of maize (Table.2). Daily water use rate and crop consumptive use were significantly lower in the sheltered groundnut compared to unsheltered. Lesser water use by sheltered crop was obviously due to lower evaporation rates probably coupled with manifestation of sheltering effect in reduced transpiration from crop canopy. Consumptive use of groundnut was lesser by 20 per cent in completely sheltered treatment (T_5) compared to unsheltered ones (T_1 and T_2). Thus sheltered treatments need one to two irrigations less compared to unsheltered and partially sheltered.

Water use efficiency was higher in sheltered treatments than unsheltered (Table 2). Highest WUE (8.34) was noticed under completely sheltered (T_5) while it was lowest (5.49) in unsheltered crop (T_1 and T_2). Higher WUE obtained with sheltering of maize is obviously due to highest pod yield and lower consumptive use of water.

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Table 1. Weather in groundnut canopy as influenced by maize as shelterbelt.

Parameter	Unsheltered*	Sheltered**
1. Wind Velocity (Km. hour^{-1})		
a. At the top of groundnut canopy	1.85	0.83
b. At the middle of the shelterbelt	3.07	2.30
c. At the top of shelterbelt	5.36	4.85
2. Mean Relative Humidity (%)	72.40	80.70
3. Evaporation (mm.day^{-1})	6.99	6.03

Table 2. Effect of maize as shelterbelt on yield, water use and WUE of groundnut.

Treatment	DMP at harvest (kg.ha^{-1})	Pod yield (kg.ha^{-1})	Daily water use (mm)	Consumptive use (mm)	WUE (kg.ha mm^{-1})
T_1	9,600	2345	4.68	425.7	5.51
T_2	9,700	2328	4.68	425.7	5.47
T_3	10,120	2524	4.67	425.2	5.93
T_4	11,440	2855	4.22	380.6	7.58
T_5	11,680	2889	3.88	346.6	8.34
T_6	11,360	2804	4.22	380.5	7.37
T_7	10,240	2497	4.62	421.4	5.92
CD (5%)	1028	193	—	—	—