Indian Journal of Agricultural Sciences **84** (6): 711–3, June 2014/Article
https://doi.org/10.56093/ijas.v84i6.41449

Impact of soil moisture and plant population on yield components and yield of maize (*Zea mays*)

T PARTHASARATHI[1], K VANITHA[2] and G VELU[3]

Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu 641 003

Received: 25 April 2012; Revised accepted: 26 March 2014

ABSTRACT

Experiment was conducted with three water levels such as 100, 75 and 50 % with three spacing, viz. normal, narrow and reduced narrow spacing of maize. Reducing the plant spacing, enhanced the plant population per unit area which increases maize yield even under reduced soil moisture level. Individual treatments of normal irrigation practice, narrow plant spacing and its interaction registered better performance of kernel, stover yield and yield attributes.

Key words: Kernel yield, Plant Density, Relative water content, Stover yield, Test weight

Maize (*Zea mays* L.) is the third most important food crop grown worldwide. Decrease of water allocation in arid and semi-arid regions lead to water scarcity with significant impact on reducing agricultural production (Kirda *et al.* 1999). Van Roekel and Coulter (2011) noted that corn hybrids have been bred for increased tolerance to the stresses associated with high plant population and drought to get maximum yield. Drought stress on maize hybrids and variety significantly affects yield parameters (Mostafavi *et al.* 2011). Interaction of irrigation and cultivar was significant on harvest index and seed yield (Khalili *et al.* 2013). The goal of present experiment is to study the effect of water deficit, plant density on maize yield and assessing the impact on yield components and its contribution to yield.

MATERIALS AND METHODS

Field experiment was conducted in Tamil Nadu Agricultural University, Coimbatore. Soil physiochemical parameters such as pH (8.34), EC (0.65 dS/m), FC (42.25 %), PWP (30.05 %), ASM (10.74 %), available NPK (420, 15.2, 550 kg/ha) and OC (0.48 %) were observed. Normal irrigation water (0.8 IW/CPE ratio: 500 mm) (I_1), 75% of irrigation water (0.6 IW/CPE ratio: 375 mm) (I_2) and 50% of irrigation water (0.4 IW/CPE ratio: 250 mm) (I_3) were supplied through main plots using COH (M) 5 maize hybrid. Irrigation water was quantified by parshall flume (Parshall 1926). Normal (S_1: 60 cm × 20 cm), narrow (S_2: 30 cm × 30 cm) and reduced narrow spacing (S_3: 45 cm × 20 cm) were adopted in sub plots. Relative water content (RWC) was estimated and expressed in percentage (Barrs and Weatherly 1962). Yield and its components were analyzed by the method of Grant *et al.* (1989) at physiological maturity. This experiment adopted split plot design with four replication and data were analyzed using ANOVA (Gomez and Gomez 1984).

RESULTS AND DISCUSSION

A significantly increased RWC of 86.7% recorded in normal irrigation with narrow spacing (Table 1) and 75% water supply with narrow spacing recorded moderate RWC (70.6%). Reducing soil moisture and increased plant population compromise the yield limitation in 75 and 50% irrigation water supply with narrow spacing. This was due to mild water deficit can recover leaf RWC to the level of normal irrigation after resuming well-watered condition (Rivera-Hernandez *et al*. 2010). The plants receiving normal irrigation and narrow spacing treatments (100% water supply with narrow spacing of 30 cm × 30 cm) registered higher grain yield of 6477.5 kg/ha which leads to higher stover yield (12602.8 kg/ha) as well as yield components such as cob length (24.3 cm), cob girth (18.5 cm), cob dry weight (144.6 g/cob), filled kernel number (410.0) and kernel dry weight (112.3 g/cob) than the rest of the treatments (Table 2). Narrow rows help offset the reduction in time by facilitating crop canopies that either reach maximum light interception by flowering or sooner than wider rows (Andrade *et al*. 2002) favoured such an increased yield and its components.

Reduction in cob length and girth under water deficit (75 and 50%) and plant population stress (reduced narrow spacing) were observed. Increased plant population produces

[1] Ph D Scholar (e mail: parthasarathicrp@gmail.com), [2] Senior Research Fellow (e mail: vanithacrp@gmail.com), [3] Professor (e mail: gopalvelu@rediffmail.com), Department of Crop Physiology

Table 1 Physiological effect of yield on maize under reducing soil moisture regimes and plant density

Irrigation/Water supply	Spacing	RWC (%)	Test weight (g)	Stover yield (kg/ha)	Kernel yield (kg/ha)
Normal irrigation (100 % water supply)	60 × 20 cm	80.6[b]	25.9[a]	11290.9[b]	5592.3[b]
	30 × 30 cm	86.7[a]	29.1[a]	12602.8[a]	6477.5[a]
	45 × 20 cm	75.4[c]	27.6[a]	10391.0[c]	5811.8[b]
75 % water supply	60 × 20 cm	68.7[e]	27.5[a]	9746.0[d]	4612.9[d]
	30 × 30 cm	70.6[e]	25.2[b]	10022.8[c]	4918.8[c]
	45 × 20 cm	70.8[d]	28.2[a]	8462.2[e]	3755.9[e]
50 % water supply	60 × 20 cm	69.2[e]	21.5[c]	7201.5[f]	3286.6[f]
	30 × 30 cm	59.3[f]	27.1[a]	7395.4[f]	3458.4[f]
	45 × 20 cm	54.2[g]	20.9[c]	7100.5[f]	2918.9[g]
Mean		70.6	25.9	9357.0	4537.0
Irrigation	CD (P = 0.05)	1.982**	1.609**	127.31**	103.00**
Spacing	CD (P = 0.05)	2.075**	1.142**	121.61**	155.58**
Irrigation × Spacing	CD (P = 0.05)	1.027**	1.311**	213.98**	242.94**
Spacing × Irrigation	CD (P = 0.05)	1.198**	0.659**	210.63**	269.47**

Table 2 Yield components of maize under irrigation regimes and plant density levels

Irrigation/Water supply	Spacing	Cob length (cm)	Cob girth (cm)	Cob dry weight (g)	Filled kernel (number)	Kernel dry weight (g)
Normal irrigation	60 × 20 cm	21.9[b]	17.5[b]	137.9[a]	363.5[a]	103.0[b]
(100% water supply)	30 × 30 cm	24.3[a]	18.5[a]	144.6[a]	410.0[a]	112.3[a]
	45 × 20 cm	21.1[c]	15.4[e]	103.9[d]	317.8[a]	86.5[c]
75% water supply	60 × 20 cm	22.5[b]	16.7[c]	126.3[b]	394.8[a]	105.4[b]
	30 × 30 cm	22.6[b]	16.1[d]	111.2[c]	373.5[a]	83.7[c]
	45 × 20 cm	22.0[b]	17.2[b]	107.1[c]	333.5[a]	74.8[d]
50% water supply	60 × 20 cm	22.2[b]	16.5[c]	121.1[b]	340.0[a]	101.7[b]
	30 × 30 cm	22.5[b]	16.8[c]	129.2[b]	323.5[a]	100.5[b]
	45 × 20 cm	21.9[b]	16.5[c]	114.2[c]	269.3[a]	82.7[c]
Mean		22.33	16.80	121.72	347.32	94.51
Irrigation	CD (P = 0.05)	0.360**	0.125**	3.165**	8.366**	2.028**
Spacing	CD (P = 0.05)	0.291**	0.148**	2.201**	18.590**	1.297**
Irrigation × Spacing	CD (P = 0.05)	0.548**	0.244**	4.439**	27.589**	2.735**
Spacing × Irrigation	CD (P = 0.05)	0.505**	0.256**	3.813**	32.198**	2.247**

smaller cobs (length and girth) due to shading effect. Mokhtarpour *et al.* (2005) also found reduction of ear length in maize. Kernel yield was closely linked to filled kernel number, test weight and harvest index are determined by the physiological efficiency of the crop (Zamir *et al.* 2011). Stover yield increases which increasing plant spacing but decreases with water deficit. Present results followed the experiment of Kheibari *et al.* (2012) in baby corn. But, further reduction causes yield decline due to competition for water and nutrients.

REFERENCES

Andrade F H, Calvino P, Cirilo A and Barbieri P. 2002. Yield responses to narrow rows depend on increased radiation interception. *Agronomy Journal* **94**: 975–80.

Barrs H D and Weatherly P E. 1962. A re-examination of relative turgidity for estimating water deficits in leaves. *Australian Journal of Biological Science* **15**: 413–28.

Gomez K A and Gomez A A. 1984. *Statistical Procedures for Agricultural Research*, 2nd Edn, p 680. John Wiley and Sons, New York, USA.

Grant R F, Jackson B S, Kiniry J R and Arkin G F. 1989. Water deficit timing on yield components of maize. *Agronomy Journal* **81**: 61–5.

Khalili M, Naghavi M R, Aboughadareh A P and Rad H N. 2013. Effects of drought stress on yield and yield components in maize cultivars (*Zea mays* L.). *International Journal of Agronomy and Plant Production* **4**(4): 809–12.

Kheibari M, Khorasani S K and Taheri G. 2012. Effects of plant density and variety on some of morphological traits, yield and yield components of baby corn (*Zea mays* L.). *International Research Journal of Applied and Basic Sciences* **3**(10): 2 009–14.

Kirda C, Moutonnet P, Hera C and Nielsen D R. 1999. *Crop Yield Response to Deficit Irrigation*, p 258. Kluwer Acadamic Publication, Dordrecht, The Netherlands.

Mokhtarpour H, Mosavat S, Bazi M and Saberi A. 2005. Effects

of sowing date and plant density on ear yield of sweet corn (*Zea mays* L. var saccharata) KSC403su. *Iranian Journal of Crop Sciences* **8**: 171–83.

Mostafavi K H, Geive S H, Dadresan M and Zarabi M. 2011. Effects of drought stress on germination indices of corn hybrids (*Zea mays* L.). *Journal of Agricultural Sciences* **1**(2): 10–8.

Parshall R L. 1926. The improved venturi flume. *Transactions, ASCE* **89**: 841–51.

Rivera-Hernandez B, Carrillo-Avila E, Obrador-Olan J J, Juarez-Lopez J F and Aceves-Navarro L A. 2010. Morphological quality of sweet corn (*Zea mays* L.) ears as response to soil moisture tension and phosphate fertilization in Campeche. *Mexico Agriculture Water Management* **97**(9): 1 365–74.

Van Roekel R J and Coulter J A. 2011. Agronomic responses of corn to planting date and plant population. *Agronomy Journal* **103**: 1 414–22.

Zamir M S I, Ahmad A H, Javeed H M R and Latif T. 2011. Growth and yield behaviour of two maize hybrids towards different plant spacing. *Cercetări Agronomice în Moldova* **2**(146): 33–40.