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Full Length Research Paper

Decreased row spacing as an option for increasing maize *(Zea mays L.)* yield in Trans Nzoia district, Kenya

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Maize yield trend has been declining in recent past. Farmers in Trans Nzoia District rarely intercrop maize with other crops like beans. With good nutrition and favourable weather conditions, decreased maize row spacing can maximise maize production per unit land area by increasing plant population density, optimal light interception and nutrient uptake. The experiment was carried out during the long rain season (April - September) for two successive years starting 2006. There were significant treatment differences (at 5%) between row spacing, varieties and interaction between row spacing and varieties. The mean yield increased with decreasing row spacing. Decreased row spacing combined with improved maize varieties is a possibility of increasing maize yield in Trans Nzoia District.

Key words: Row spacing, maize varieties, yield, interaction.

INTRODUCTION

The significance of maize (*Zea mays L.*) in households in Trans Nzoia District cannot be overemphasised (Onyango et al., 2000). In fact, Nyamangara et al. (2003) reported that the smallholder cropping in much of southern and eastern Africa is based on maize, the staple food crop. Other than being staple food crop, maize is a cash crop as well as source of employment both at farm and industry levels thereby directly or indirectly affecting livelihoods of many people in the District. Unfortunately, maize yield trend has been declining in the recent past. The cost of production of this crop is often in excess of the accrued cash returns thereby discouraging its production. This has negatively impacted not only on the people of Trans Nzoia but also those beyond the District since Trans Nzoia is a net exporter of maize, stereotyped 'grain basket' of Kenya. The declining yield trend has been partly attributed to increased human population against non-expansible land as a natural resource. The increased population pressure on land has caused subdivision of large tracks of agricultural farmland into individual small parcels for human settlement thereby reducing land area under arable agriculture. To sustain this increased population, it is only wise to increase the productivity of the remaining farmland.The blanket traditional maize inter row spacing of 75 cm has been used indiscriminately since time immemorial, without taking into account the myriad morphological and genetic differences that exist between and among maize varieties. Moreover, farmers in Trans Nzoia District rarely intercrop maize with other crops like beans. It is hypothesised that with good nutrition and water supply, decreased maize row spacing can maximise yield per unit land area by increasing plant population density, optimum light interception and nutrient uptake. It is against this background of understanding that this experiment was conceived: to explore reduced row spacing as an economically viable, ecologically non-degrading and socially acceptable cultural practice that can enhance yield per unit land area in Trans Nzoia, thereby leading to increased food self-sufficiency, food security, employment, industrial raw material and possibly increased foreign exchange earnings.

MATERIALS AND METHODS

Plant material and experimental design

The experiment was conducted at KEPHIS-Kitale Regional Office farm. The treatments included three inter row spacing (75, 60 and 50 cm) and some five common late maturity maize varieties (H 614D, H 6213, H 9401, H 628 and H 629) at a standard intra-row spacing of 25 cm. This was a factorial experiment laid out in a complete randomised block design (CRBD) with row spacing being main factor and variety as sub-factor, giving a total of 15 treatments. The block was folded 3 times. The treatments were replicated three times.

Each plot measured 5 m × 3 m. Planting was done at the onset of rains each season. Two seeds were planted in each hole and later thinned to one plant per hill soon after emergence. All agronomic

Table 1. Analysis of variance for mean treatment effects (ANOVA).

Source	df	SS	MS	F value	P>F
Year	1	0.0001111	0.0001111	0.00	0.9959[ns]
Rep (year)	4	21.2859259	5.3214815	1.32	0.2852[ns]
Row spacing	2	86.1942963	43.0971481	10.6	0.0003**
Rep × row spacing (year)	8	64.8197037	8.1024630	2.00	0.0782[ns]
Year × row spacing	2	0.0000741	0.0000370	0.00	1.0000[ns]
Variety	4	56.6240247	14.1560062	3.50	0.0177*
Rep × variety (year)	16	64.1758025	4.0109877	0.99	0.4883[ns]
Year × variety	4	0.0032840	0.0008210	0.00	1.0000[ns]
Row spacing × variety	8	105.565822	13.1957284	3.26	0.0079*
Year × row spacing × variety	8	0.0030123	0.0003765	0.00	1.0000[ns]

KEY: Ns, not significant at 5%; *, Significant at 5%; **, Significant at 1% (highly significant); CV = 19.0%.

Table 2. Probabilities of row spacing differences.

	Probabilities			
Row spacing	Yield (KG)	50 cm	60 cm	75 cm
50 cm	11.66[a]	.	0.2283	0.0089
60 cm	10.76[a]		.	0.0659
75 cm	9.29 [b]			.

practices were uniformly applied across the treatments. At physiological maturity, plots were harvested separately and yield subdivided into clean and rotten/sprouted cobs. The yield was shelled, dried to 13.5% kernel moisture content and weighed. The experiment was conducted for 2 consecutive years beginning 2006. Data was statistically analysed using SAS computer package (SAS, 1998).

RESULTS AND DISCUSSION

There were significant treatment differences between row spacing, variety and interaction between row spacing and variety (Table 1).

The data presented is for two years combined, each time the treatments are being replicated thrice.

Effect due to row spacing

The mean yield increased with decreasing row spacing. However, there were no significant differences in yield between 50 and 60 cm row spacing (Table 2). Decreased row spacing implies high plant density, which is concomitantly equal to high yield with every successful ear formation per plant.

It also improves water use efficiency since evaporation losses are reduced as ground cover increases. Moreover, the dense crop canopy smothers weeds thereby reducing resource competition. This finding is in contrast to research findings in Argentina by Maddonni et al. (2006) which shows that maize grain yield was stable in response to changes in plant spatial arrangement at all plant population densities. Tollenaar et al. (2006) in their research finding argued that a moderate increase in plant-spacing variability does not influence maize grain yield at the canopy level because reductions in grain yield of plants that experience enhanced crowding stress is compensated, in part, by increased yield of plants that experience reduced crowding stress.

However, it is worth mentioning that decreasing row spacing has socio economic implications: high plant population densities means upward adjustment of the amount of agro inputs used (seed rate and fertilizer). Manual weeding, harvesting and other agronomic maintenance operations would take more labour and time, as it is difficult working through the dense crop stand.

Effect due to variety

New varieties performed better than the old varieties, with H 6213 being the best and H 614D giving the least yield (Table 3). This is in agreement with findings by Owino (unpublished data). The findings reaffirm breeders' commitment to produce new and improved high yielding varieties. However, there were no significant yield differences among H 6213, H 9401 and H 628 on one hand and between H 614D and H 629 on the other hand. The challenge is to convince farmers to adopt these new varieties and drop the old ones.

Conclusion and Recommendation

The observed increased maize grain yield under decreased row spacing may be attributed to improved intercepted photosynthetic active radiation (IPAR), radiation use efficiency (RUE) and azimuth leaf distribution of a genotype so long as critical leaf area index (LAI) is not exceeded. "Plastic genotypes" re-orientate their leaves in horizontal plane to fill empty space inorder to maximise photo-interception as opposed to "rigid genotypes" that present random leaf azimuth independently of spatial

Table 3. Probabilities of variety differences.

		Probabilities				
Variety	**Yield**	**H 6213**	**H 9401**	**H 628**	**H 629**	**H 614D**
H 6213	11.34[a]	.	0.7157	0.7016	0.0911	0.0059
H 9401	11.09[a]		.	0.9848	0.1727	0.0128
H 628	11.07[a]			.	0.1783	0.0133
H 629	10.13[ab]				.	0.1881
H 614D	9.21[b]					.

arrangement. Decreasing row spacing seems to be an alternative that can be used to intensify crop production per unit land area. However, varieties are likely to perform differently under different planting densities owing to their different genetic and phenotypic characteristics. More work should be done to develop and identify varieties that are best suited to closer row spacing with high radiation use efficiency. The experiment was done in one site and needs to be repeated in several sites to confirm the so far observed trend.

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REFERENCES

Maddonni GA, Alfredo GC, Otegui ME (2006). Row width and maize grain yield. Agron. J. 98: 1532-1543.

Nyamangara J, Bergstron LF, Piha MI, Giller KE (2003). Fertilizer Use Efficiency and Nitrate Leaching in a tropical Sandy Soil. J. Environ.Qual., 32: 599-606.

Onyango RMA, Mwangi TJ, Wanyonyi M, Barkuto JK, Lunzalu EN (2000). Verifying the Potential Use of Inorganic and organic Fertilizers and their Combinations in Small Holder Maize Production Farms in Trans Nzoia District, KARI-NARC-Kitale.

Owino CO (Unpublished). Fertilizer Options for Sustainable Maize Production in Trans Nzoia District-Kenya

SAS Institute (1998). SAS/STAT Users guide Version 7. ed SAS Inst.Cary, NC USA.

Tollenaar M, Deen W, Echarte L, Weidong L (2006). Effect of Crowding Stress on Dry Matter Accumulation and Harvest Index in Maize. Agron. J. 98: 930-937.