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Influence of Spacing and Seed Rate on Weed Suppression in Finger Millet (*Eleucine carocana gaertn*)

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Abstract: Field experiments were carried out to study suitable spacing and seed rate that can suppress weeds and enhance the competitive ability of finger millet (*Eleucine coracana* (L.) Gaertn.) against weeds in 2007 and 2008 raining seasons at Samaru Zaria, Northern Guinea Savanna of Nigeria. The treatments consisted of five inter -row spacing (10, 15, 20, 25 and 30 cm) and five seed rates (10, 15, 20, 25, and 30 kg/ ha). The treatments were factorially arranged and laid out in a Randomized Complete Block Design with three replications. The result shows that both spacing and seed rate had the ability of suppressing weeds. Higher seed rate and narrow spacing had strong and negative effects on weed biomass and positive effects on crop biomass and yield.

Key words: Finger millet · Seed rate · Spacing

INTRODUCTION

Finger millet (*Eleucine coracana* (L.) Gaertn.) is a stable cereal food crop for millions of people in the semi arid region of the world, particularly in Africa and India, and especially those who live by subsistence farming. This crop is cultivated in a wide geographical zone ranging from Senegal, Niger, Nigeria, across eastern and southern Africa, through the Middle East and into tropical Asia [1,2]. The world annual production stands at 4.5 million metric tonnes, of which 2.0 million is produced in Africa from an estimated land area of about 19 million hectares [1]. Nigeria with an average yield of 580-785kg/ha account for 44% of total production on the continent. Finger millet is grown in the northern parts of the country, cultivated mostly in combination with pearl millet. This plant, though not produced in large quantity in Nigeria compared to other cereals, is an important crop because of its high nutritive value. It is rich in minerals, such as calcium, iron, and phosphorus, [3] and essential amino acids which include methionine and tryptophan [4].

One of the major constraints in finger millet production in the field is weed management [5]. This is because seeds are usually sown by broadcasting, making manual hoe weeding which is the common weed control approach in this area difficult and time consuming. Weed management in any crop production practice is limited to five options, preventive, biological, cultural, mechanical and chemical control methods. Choice of a particular method or methods depends upon the weed spectrum and crop notation sequence among others. It is important to employ several options in millet production because chemicals that can be used for weed control are limited [6], moreover the need to reduce the use of herbicides is being advocated. A more cautious and effective way to control weeds is by manipulating cropping system and making condition more favorable for crop and unfavorable for weed growth [7]. This is possible by adopting some agronomic or management practices, which enhance the crop ability to compete more effectively against the weeds. Crop population, spatial arrangement and choice of cultivar can affect weed growth. Crop competitive ability can be enhanced by choosing a density and arrangement for the crop or combination of crops that the maximum space will be filled in the shortest possible time with crops rather than weeds. For example fast growing cultivar can have a competitive edge over weed. Deep drilling may decrease the competitive ability of crop against the weeds [8]. This therefore calls for the present study aimed at determining the most suitable inter-row spacing and seed rate that can effectively suppress weeds in finger millet.

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MATERIALS AND METHODS

Two field experiments were conducted during the 2007and 2008 raining seasons at Samaru, Zaria. The soil of the two different experimental sites was sandy loam, with nutrient content of 0.008%N, 7.33 ppm, available P, 0.33% organic carbon and 0.22 Meq/100g (H+AC) exchangeable acidity (Table 1). The experiment in the two years was laid out in a randomized complete block design with three replications. The treatments consisted of five inter-row spacing (10, 15, 20, 25, and 30cm) and Five seed rates (10, 15, 20, 25, and 30kg / ha).

The gross and net plot sizes were 9 and 6 m^2 respectively. The experimental site in each year was ploughed – harrowed twice at the beginning of each raining season, and the land was then marked into the required number of plots. Sowing was done on July 1st, in both 2007 and 2008, by drilling. In both years, N.P.K 15: 15: 15: was applied by side drilling to supply 30kg N, 30kg P and 30kg K per hectare to crop reactively. All nutrients were applied in two equal split doses at 3 and 6 weeks after sowing (WAS). The crop was harvested at maturity on the 27th November in 2007 and on 15th January, 2008. This was done by cutting the plants about 5cm above the ground using sickle. The plants were threshed on a floor by beating with sticks and winnowed to remove straw, foreign material and unfilled grains.

Data collected included weed flora composition, crop vigor score, weed cover score, crop dry matter and grain yield. The crop vigor score was taken by visual assessment using a scale of 1 to 10 where, I represented no weed cover and 10 represented complete weed cover. The plant height was taken by measuring the plant with a meter rule from the ground level to the tip of flag leaf and later to the tip of panicle of five plants and the average recorded. The grain yield was taken by measuring the grains from each plot after threshing and winnowing on a metler sensitive balance and the final weight of the grain was then converted to kg/ha.

The data collected were subjected to Analysis of Variance for test of significance of difference between the means which were compared using Duncan Multiple Range Test (DMRT) [9] at P 0.05 level of probability.

RESULTS AND DISCUSSION

Weed Flora, Composition and Frequency: The relative composition and frequency of various weed species among the five methods of spacing under the five seed rate is shown in Table 2. The occurrence of weed was relatively higher in 25-30cm spacing and 10 -15kg seed rate. Annual weeds dominated the trial. Generally, across the treatment grassy weeds dominated the weed flora while broad leaved weeds were the least occurring in the

Table 1: Physico-chemical properties of the soil of the experimental site during the 2007 and 2008 wet seasons at Samaru, Zaria, Nigeria

	Soil Content Soil Depth (cm)			
	2007		2008	
Soil Properties				
Physical Properties	0-15	15-30	0-15	15-30
Clay	14.0	12.0	18.0	16.0
Silt	19.2	71.8	56.0	58.0
Sand	66.0	16.2	26.0	26.0
Textural Class	Sandy Loam	Silt Loam	Silt	Loam
Chemical Properties				
Organic Carbon (g/kg)	0.52	0.32	8.20	7.20
Total Nitrogen (g/kg)	0.32	0.16	1.10	0.60
pH in H_20	6.10	5.90	5.17	5.46
pH in 0.01 $Cacl_2$	6.00	5.70	4.59	4.39
C.E.C (Meq/100g)	5.00	4.83	6.20	5.70
Exchangeable Bases				
Available Phosphorus (mg/kg)	5.11	8.90	12.3	14.20
Ca (Meq/100g)	0.40	0.60	0.67	0.57
K (Meq/100g)	0.16	0.14	0.21	0.16
Na (Meq/100g)	0.28	0.16	0.37	0.18
Mg (Meq/100g)	0.37	0.13	0.12	0.09

All samples were analysed in soil science laboratory, Institute of Agricultural Research Ahmadu Bello University Zaria Nigeria

Table 2: Influence of spacing and seed rate on weed composition and frequency of weed occurrence in finger millet at Samaru, Zaria Nigeria, during the 2007 and 2008 wet seasons

Weed Family	Weed Type	Abundance	Frequency
Cyperaceae	*Cyprus rotundus* Linn + 0		
Asteraceae	*Chromolaena odurata (*L*)*		
	R.M King and Robinson + 0		
Coesalpiniaceae	*Cassia spp* + 0		
Convolvulaceae	*Ipomoea eriopcarpa R.B*	+++	00
Commelinaceae	*Commelina benghalensis.L*	++	00
Malvaceae	*Hibiscus asper* Hook f.	++	00
Poaceae	*Digitaria horizontalis Willd*	++++	0000
	Eleusine indica Gaern	++++	0000

+ - Low ++ - Moderate +++ - High ++++ - Very high

0 – Low 00 – Moderate 000 – High 0000 – Very high

Table 3: Influence of spacing and seed rate on weed cover, weed dry weight and crop vigour of finger millet at Samaru – Zaria during the 2007 and 2008 wet seasons

	Weed Cover Score		Weed Dry Matter		Crop Vigour Score	
Treatment Spacing (cm)	2007	2008	2007	2008	2007	2008
10	1.0^{d}	2.8^{e}	29.85^{e}	31.80^{b}	7.20^{b}	8.6^{b}
15	2.0^{c}	2.3^{d}	32.83^{d}	38.65^{d}	7.5^{a}	8.5^{b}
20	4.5^{b}	6.0^{c}	36.82^{c}	38.84^{ab}	8.1^{a}	9.0^{a}
25	6.0^{a}	7.7^{b}	37.25^{b}	40.24^{a}	8.2^{a}	9.0^{a}
30	7.0^{a}	10.0^{a}	42.36^{a}	41.86^{a}	8.2^{a}	9.0^{a}
SE ± Seedrate (Kg/ha)						
10	6.3^{a}	7.8^{a}	44.73^{a}	48.70^{a}	8.0a	8.8^{a}
15	3.9^{b}	6.7^{b}	39.61^{b}	43.40^{b}	8.8^{a}	8.3^{a}
20	1.5^{c}	5.5^{c}	30.09^{c}	31.00^{c}	6.6^{b}	7.4^{b}
25	0.8^{d}	3.0^{d}	24.58^{d}	29.65^{d}	6.4^{b}	7.5^{b}
30	0.7^{d}	2.0^{e}	17.10^{e}	29.07^{d}	7.5^{b}	7.5^{b}
SE±	0.478	0.470	1.030	1.051	0.289	0.110

Values followed by unlike letter(s) are not significantly different at (p=0.05) DMRT. WAS=Weeks after sowing

WCS=Weed cover score using scale 1-10 where 0=complete weed cover and 10= no weed cover

CVS= Crop vigour score using scale 1-10 where 0=completely dead plant and 10=very healthy plants.

Table 4: Influence of spacing and seed rate on crop dry matter and yield of finger millet at Samaru, Zaria during the 2007 and 2008 wet seasons

	Crop Dry Matter at 9WAS		Grain yield kg/ha	
Treatment Spacing (cm)	2007	2008	2007	2008
10	18.24	16.35	3829a	2910a
15	17.84	17.22	3790b	2825a
20	17.91	17.07	2945c	2771b
25	18.05	16.55	2681d	1768b
30	18.48	17.13	2665d	1537c
SE ± Seed-rate (Kg/ha)				
10	14.65c	14.26c	2598d	1478d
15	15.40bc	16.51b	2701c	1736c
20	17.26b	17.48b	2739b	1785b
25	21.81a	20.58a	3822a	2872a
30	21.41a	20.86a	3848a	2987a
SE±	0.691	0.143	10.070	37.500

Values followed by unlike letter (s) are not significantly different at (p=0.05) DMRT. WAS=Weeks after sowing

trial. The wider spacing of 20–30 cm comprised of all the different weed species identified in the trail compared to narrow spacing of 10–15cm. This agrees with the report by Baker [6] that when millet is grown in narrow spacing, Lower weed pressure and weed composition was observed. The predominant grassy weeds observed were mostly *Eleusine indica* and *Digitaria horizontalis* while among the broad leaved weeds *Ipomoea eriopcarp* was most occurring followed *Cornmelina banhalensis* and *Hibiscus asper* (Table 3). This indicates that narrow spacing had negative effect on weeds particularly broad leaved weeds grasses .This could probably be due to the fact that finger millet is a tillering crop whose canopy together with narrow width and higher crop density as a result of higher seeding rate reduce the amount of light available for weeds growing below the canopy of the millet crop. It is therefore necessary to use narrow spacing to suppress weeds which will eventually lead to increase yield.

Weed and Crop Response: Marked decrease in weed cover was observed in plots spaced closely at 10 and 15cm. This could be as a result of shading effect from the canopy of the closely spaced finger millet which also has high tillering ability, this agrees with the report by Curran *et al*. [10] that narrowing the crop row spacing, increase the competition and shading ability of crop and thus improve weed management. Planting finger millet at 25 and 30cm inter row spacing gave higher weed cover score. This agrees with the report by Akobundu [11] that widely spaced plants are less competitive than narrowly spaced crop. Generally narrow spacing gave a better yield and weed control than wider spacing. This agrees with the report by Baker (1996) who also made the same observation. When millet was planted at 10 and 15kg/ha, higher weeds cover was observed. Followed by 20kg/ha seed rate. Planting millet at 25 and 30kg/ha seed rate gave the lowest weed cover score. The highest weed density and weed dry matter were observed when wheat was planted at lower seed rate [12,13]. Increased crop density had strong and consistent negative effect on weed biomass and positive effect on crop biomass and yield. Most vigorous crop was observed when finger millet was planted at 20-30cm spacing and 10-15kg seed rate per hectare. This could be as a result of the wider space between the crop while allowing for less interaction between the plant. At the highest crop density, weed biomass was less than half than at the lowest density. The highest yield was observed at 10 cm spacing and 25 and 30kg/ha seed rate. This can be attributed to better weed suppression observed when millet was planted at spacing of 10 and 25cm and 30kg/ha seed rate.

CONCLUSION

In this study, to avoid the build up of weeds, close spacing and higher seed rate could be adopted as an alternative for the control of weeds in finger millet.

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