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Effect of gathering stems on growth and yield of oilseed *Citrullus lanatus* ((Thumb.) Matsum. & Nakai)

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Abstract :

Improvement of agricultural system rest an evident way to reduce poverty and food insecurity in Sub-Saharan of Africa. *Citrullus lanatus* is produced for its oleaginous seeds which are economically important in Ivory Coast. But its production is very low due to a traditional system mainly the gathering of its stems. Thus for sustainable of this crop, a field trial was undertaken at Gbokora (Daloa) to investigate effect of gathering stems on growth and yield of this cucurbit. The experiment consisted to gather the stems of *C. lanatus* at two phenological stages and a control. In total three treatments were take place: T0 : Control, T1 : Treatment 1 (Stage male) and Treatment 2 (Stage female) in randomized complete design with three replications. The results of statistical analysis showed that the gathering of *C. lanatus* stems boosts it production comparatively to control. The highest value of yield and its components were recorded with the treatment 2. Basing on this result, it was recommended to farmers to gather the stems of *C.lanatus* during a male stage to insure the production of this crop.

Keywords : *Citrullus lanatus*, gathering stems, Cropping system, Ivory Coast

1. Introduction

The major problems of many people in developing countries are security and food self-sufficiency. During the next years, African agriculture will face a challenge, to support the food needs of its growing population .This policy will be based on the production improvement of subsistence crop de (de Graaff *et al.*, 2011). External to its insufficiency production, this crop is still unable to generate income for rural population. Search for new solutions to stabilize the income of farmers is imperative for an acceptable living conditions in rural areas. It is in this way that crop diversification offers opportunities to promote new agricultural resources. The exploitation of local resources particularly neglected crops could diversify agricultural activities (Bannayan *et al.*, 2011). In Ivory Coast, oilseed cucurbits particularly *Citrullus lanatus* ((Thumb.) Matsum.& Nakai) could profit with new income to farmers (Zoro Bi *et al.*, 2006). Besides its culinary value, *C. lanatus* is a source of income to producers mainly women. On the various markets the price of the kilogram of cleaned and dried seeds is sold at 1.500FCFA (Zoro Bi *et al.*, 2003). Economically, attractive and deeply integrated in traditional African cultures, farmers embarck on large scale production of this cucurbit. However, its production remains very low in agro-systems due to the gathering of its stems during weed control. The very high sensibility of *C. lanatus* constitutes a problem for the farmers. Indeed, cucurbit is reported as a poor competitor with *Cyperus esculentus* (Buker *et al.*, 2003). According to authors absence of control of weeds conduct the loss of 50 % production of this cucurbit. Farmers gather the stems of this cucurbit in order to clean better theirs farms. A such practice cultural could have a heavy consequence on the production of the oilseed *C. lanatus*. This study aimed to investigate the impact of gathering stems of this cucurbit on yield and its components.

2. Material and methods

2.1. Study site

Field experiments were conducted in 2016-2017 at Gbokora (latitude: 06° 53′ 58′′ N and longitude: 06° 26′ 32′′W) located in Daloa (Ivory Coast). This site is characterized by two rainy seasons separated by a short dry period (mid-July-mid-September) and a long dry season (December-March). Annual rainfall varies from 1000 to 1500 mm. Also, this area have a mean temperature ranging between 21-35°C along the year. Its vegetation is largely constituted by the dense forest (Gore Bi *et al.*, 2016)

2.2. Plant material and experimental design

The planting material was constituted of 270 plants of oilseed *C. lanatus*. The seeds of those plants were obtained from the market of Gohitafla (Zuenoula, Ivory Coast). This cultivar is characterized its medium size and it is widely cultivated in Ivory Coast.

Experimental design was a block complete randomized with three replications by treatment. Thus a total of 9 plots were performed. In each plot, sowings were done according to three treatments: (a) Treatment 0 (T0): No gathering of plants stems on this plot; (b): Treatment 1 (T1): The stems of plants were gathered from first stem emergence until first male flower opening. (c): Treatment 2 (T2): The stems of plants were gathered from first male flower opening until first female flower opening. To ensure proper stand, five seeds per hole were sown directly and thinned to one plant per hole at the two-leaf stage. All plants per treatment including control were investigated. Any fertilizer or irrigation was applied during the trials. Weeds were manually controlled and the crop was sprayed with insecticide (Cypercal EC 50) to protect the crop against cucumber beetle, *Zonocerus variegatus* and lady beetle identified in study site.

2.3. Data collections and statistical analysis

From sowing to harvest, two vegetative parameters (Length of plant (LoPl) and Number of ramification (NoRa)) and two production parameters (Number of fruits per plant (NFrPl) and Number of abortion fruits per plant (NFrAvPl)) were collected. Then five others production parameters were completed after harvest (Weight of fruit (WFr), Number of seeds per fruit (NSeFr),: Weight of seeds per fruit (WSeFr), Weight one hundred seeds per fruit (W-100SeFr), Yield (Yld).

Significant effect of gathering stems was tested with ANOVA. When a significant effect is found for this factor, each parameter was examined by using the software SAS statistical package. In case of a significant difference the Least Significant Difference (LSD) multiple range-tests were used to identify the means those differ.

3. Results

3.1. Effect of gathering stems on parameters of plant

Analyses of **table 1** shows that gathering stems has influenced on the two parameters tested. The highest plant stem were recorded on plot which have stems collected during male stage. It is also on the same plots that plants have produced more ramifications. On the control plot plants have recorded lower values of the two parameters than the treatment T1 and T2.

Table 1. Effect of gathering stems on parameters of plant

Treatments	Lopl	NoRa
T1	3,767±0,374a	40,235 2,365
T2	3,635±0,374b	27,500±2,298
T0	3,396±0,529c	16,375±3,448
F	208,349	310,810
P	0,000	0,000

Lopl : Length of plant, NoRa : Number of ramification F: F-statistic of Fischer and P: probability associated with the test. For each parameter, the values with the same letters are statistically equal ($P \geq 0.05$).

3.2. Effect of gathering stems on parameters of fruits

The three parameters of fruits were influenced by the gathering of stems. Plants have produced more and heavies fruits on the plots which have stems collected during male stage. The two parameters have recorded theirs lowest values on the control plot. It is on the same plot that a lot of fruits have aborted on the comparatively to the two others treatments (**Table 2**).

Table 2. Effect of gathering stems on parameters of plant and fruits

Treatments	NFrPl	WFr	NFrAvPl
T1	3,412±0,341a	0,838±0,051a	0,647±0,179b
T2	2,722±0,331ab	0,648±0,047b	1,667±0,173c
T0	1,40±0,512b	0,667±0,092ab	0,375±0,261a
F	131,094	352,554	55,521
P	0,000	0,000	0,000

NFrPl: Number of fruits per plant, WFr: Weight of fruit (kg), NFRAvPl : Number of fruits aborted per plant F: F-statistic of Fischer and P: probability associated with the test. For each parameter, the values with the same letters are statistically equal ($P \geq 0.05$).

3.3. Effect of gathering stems on parameters of seeds

Results of statistical analysis indicated that parameters of seeds were boosted by the gathering of stems. The fruits with more and heavies' seeds have been produced on the plants from the treatment T1. In contrary, on the control plots fruits have recorded few and light seeds. Concerning, the weight of hundred seed (W-100SeFr) the highest value of this parameter was obtained on plants from the treatment T1. Also, the lowest value of the same parameter was recorded on plants from treatments T0 (**Table 3**).

Table 3. Effect of gathering stems on parameters of seeds

Treatments	NSeFr	WSeFr	W-100SeFr

T1	492,706±33,339a	31,089±2,300a	6,218±0,210a
T2	449,000±31,536b	27,657±2,175b	6,125±0,199b
T0	402,714±51,956c	23,387±3,584c	5,829±0,328c
F	376,131	295,059	1727,209
P	0,000	0,000	0,000

NSeFr: Number of seeds per fruit, WSerFr: Weight of seeds per fruit (g), W-100SeFr : Weight one hundred seeds per fruit, F: F-statistic of Fischer and P: probability associated with the test. For each parameter, the values with the same letters are statistically equal ($P \geq 0.05$).

3.4. Effect of gathering stems on seed yield

The seed yield was influenced by the gathering of stems. A better value has been obtained on plants from treatment T1. The plants from treatments T0 were recorded the lowest value of seed yield (**Table 4**).

Table 4. Effect of gathering stems on seed yield

Treatments	Yield (t/ha)
T1	10,937±1,412
T2	7,909±1,372
T0	4,681±2,058
F	68,22094
P	0,000

Yld: Yield (t / ha). F: F-statistic of Fischer and P: probability associated with the test. For each parameter, the values with the same letters are statistically equal ($P \geq 0.05$).

4. Discussion

Improvement of traditional system of crops is an important step to face food security in sub-Saharan Africa. Thus for sustainable production of oilseed *Citrullus lanatus* ((Thumb.) Matsum.& Nakai) a study was undertook to investigate effect of the gathering stems on yield and its components. The results of analysis indicated that treatments T1 and T2 have recorded the best values of yield and its components comparatively to treatment T0. A such result reveals that the gathering of stems could be consider as a production factor of this cucurbit. Two arguments would explain this current result precisely humidity and number of ramification on main stem.

Experience take place in March 2017 and rain was unfrequented at this moment. In the other word plants had needed a water in order to improve its production. Indeed, according to Fandika et al (2011) the reproductive stage of cucurbit is very sensitive to water stress. Thus the plants from plots T1 and T2 had benefited of humidity around plants after collecting theirs stems.

The plants from plots T1 and T2 are also recorded a great number of branches on the main stems. Indeed, working on relationships between fruit yield and yield components in several cucumber (*Cucumis. sativus* L.), Cramer and Wehner (2000) showed that this parameter have a direct relation with the yield of cucurbit. This trend observed, has been explained by the exploitation of a great soil surface to uptake nutriments in order to produce more fruits.

Our results also showed that the values of yield and its yield were better with treatment T1 than treatment T2. A low number of fruits and strong rate of abortion of fruits recorded on plots with

treatment T2 underline clearly the necessity of gathering the stems of this cucurbit during male stage to improve its production. Indeed according to Nerson (2007) the number of fruits is a dominant component to increase the crops yield per area. However, the collect of branches took place between sprouting and opening the first male flower on each plant. This involves that the reproductive stage of this cucurbit was not affected.

5. Conclusion

The current study showed the gathering of cucurbit stems could be used as a factor production of this crop. Indeed, the both treatments which involves the gathering of *C. lanatus* stems recorded a better value of yield than the control. Also, it is the gathering of stems at stage male or treatment 2 that let the plants to obtain those results..

6. References

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