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Effect of seeding depths on growth and yield of oilseed Citrullus lanatus ((Thumb.) Matsum. & Nakai)

Gore Bi Boh Nestor[1]*, Bonny Beket Severin[2], Koffi Ahébé Marie Hélène[1], Bakayoko Namory[1] and Akaffou Doffou Sélastique[1]

1. Departement of Agronomy and Forestery, University of Jean Lorougnon Guede, BP 150 Daloa, Ivory coast.

2. Departement of Science of Nature, University of Nangui Abrogoua, 02 BP 801 Abidjan 02, Abidjan Ivory coast.

*Corresponding author : bgorebi76@yahoo.fr

Abstract :

Oilseed *Citrullus lanatus* ((Thumb.) Matsum. & Nakai) is an economical and social plant cultivate in Ivory Coast. But its production is very low due to a traditional system mainly the inappropriate seeding depth. Thus for sustainable of this crop, a field trial was undertaken at Gbokora (Daloa) to investigate effect of different seeding dephts on growth and yield of this cucurbit. The experiment was consisted of three level of seeding depths (0 cm, 3 cm and 5 cm) in randomized complete design with three replications. The results of statistical analysis showed only vegetative stage of cucurbit was boosted by sowing depth. The highest value of those parameters were recorded with deep seeding at 2 cm.

Keywords : Oilseed *Citrullus lanatus*, Seeding depth, Cropping system, Ivory coast

1. Introduction

Food security is a permanent access of all to the foodstuffs necessary for a healthy and active life. Basing on this definition, achieving food security remains a major challenge in sub-Saharan Africa (Goossens, 1997). Indeed, these countries are characterized by insufficient local food production to satisfy the needs of their population (Garcin & Peltier, 2013). To guarantee access to food for the people, the agricultural policy of African leaders must be oriented towards the diversification of cultures. In other word, it will be useful to integrate underutilized crops into this policy. Among them are oilseed cucurbits mainly *Citrullus lanatus* (Thunb.) Matsum. & Nakai. This species is highly cultivated in Ivory coast for its nutritive and lucrative values (Zoro Bi et al., 2003). Despite the large areas cultivated by farmers to improve their income, production of this cucurbit remains very low. According to Baudoin (1995), the traditional cropping system of African countries is the basis for such a level of crop production. Under these conditions, it is imperative to improve local farming practices through the integration of horticultural technics, particularly the seeding depth. The control of this factor of production is crucial to success production of any crop (Koffi et al., 2015). Apart from ecological factors (temperature and rainfall) and physiological state of the seeds (germinative power and dormancy), the precocity and the

uniformity of the germination is conditioned by the seeding depth. Such a database is not yet available for oleaginous cucurbit *C. lanatus*. Thus, this study was undertaken to optimize the production of this plant. Specifically, it will be necessary to study the influence of seeding depth on the yield and its components of this cucurbit.

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 (Koffi et al., 2014; Morel, 2014).

2.2. Plant material and experimental design

The planting material was constitued 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 treatments. Thus a total of 9 plots were performed. In each plot, sowings were done according to three seeding depths : (a) surface : sowings realized at 0 cm, (b) : low depth : sowings realized at 2 cm and (c) high depth: sowings realized at 5 cm (control).

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, three viability parameters (Duration of germination (DGe), Rate of germination (RGe) and Speed of germination (SGe)), five vigor parameters (Duration of emergence (DEm), Rate of emergence (Rem), Speed of emergence (Sem), Length of seedlings (LS) and weight fresh of seedlings (FWS)), one vegetatif parameter (length of plant) and one production parameter (Number of fruits per plant (FrPl)) 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 (WGrFr), Weight one hundred seeds per fruit (W-100Fr), Yield (Yld).

Significant effect of seeding depth 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

With the three treatments, only low and high seeding depths recorded results during this experience. The sowings at surface did not favour any sprouting of the seeds. Thus the results of this treatment would not be consider for the rest of the results.

3.1. Effect of seeding depth on viability paramaters of oilseed *C. lanatus*

Result of analysis test, showed that duration and speed of sprouting were influenzed by seeding depth. The best values of both parameters (were recorded on the plot with low seeding depth (Table 1).

3.2. Effect of seeding depth on vigor paramaters of oilseed *C. lanatus*

Except the rate of seedling emergence, the others vigor parameters tested were boosted by seeding depths. The best values of the four parameters were observed on the plot with low depth (Table 2).

3.3. Effect of seeding depth on vegetatifs paramaters of oilseed *C. lanatus*

Analysis of vegetatifs parameters indicated that the seeding depth has influenced the length of plant. Thus plants with the very length stem were obtained on the plots with low seeding depths (Table 3).

3.4. Effect of seeding depth on production of oilseed *C. lanatus*

Analysis of table 4 shows that the seven parameters of production tested only the number of fruits were influence by seeding depth. The most number of fruits per plant were produced on the plot with low seeding depth.

Table 1 : Effect of seeding depths on viability parameters of oilseed *C. lanatus*

Parameters	Seeding depths		Statistics Test	
	Low	High (Control)	*F*	*P*
DGe (day)	3,59±0,07[a]	4,90±0,07[b]	9,65	0,002
RGe (%)	97,77±2,83[a]	93,32±2,83[a]	1,23	0,328
SGe (seedlings/day)	6,80±0,22[a]	5,30±0,22[b]	9,77	0,004

DGe : Duration of germination, RGe : Rate of germination et SGe : Speed of germination, F : F-statistic of Fisher et P : Probability associated with test. For each parameters, the values bearing same letter are statistically similars ($P \geq 0,05$).

Table 2 : Effect of seeding depths on vigor parameters of oilseed *C. lanatus*

Parameters	Seeding depths		Statistics Test	
	Low	High (Control)	*F*	*P*

DEm (day)	7,39±0,08[a]	9,04±0,08[b]	31,20	<0,001
Rem (%)	97,77±2,83[a]	93,32±2,83[a]	1,23	0,328
SEm (seedlings/day)	3,54±0,10[a]	2,30±0,10[b]	9,88	0,006
Les (mm)	19,73±0,65[a]	18,20±0,66[b]	8,61	0,004
WFSe (g)	3,74±0,02[a]	2,32±0,02[b]	9,44	0,002

DEm : Duration of emergence, REm : Rate of emergence, SEm : Speed of emergence, LS: Length of seedlings and FWS : weight fresh of seedlings. F : F-statistic of Fisher et P : Probability associated with test. For each parameters, the values bearing same letter are statistically similars (P ≥ 0,05).

Table 3 : Effect of seeding depths on vegetatif parameters of oilseed *C. lanatus*

Parameters	Seeding depths		Statistics Test	
	Low	High (Control)	*F*	*P*
LPl (m)	4,00±0,34[a]	2,81±0,34[b]	5,90	0,019

Lpl : Length of plant (m), F : F-statistic of Fisher et P : Probability associated with test. For each parameters, the values bearing same letter are statistically similars (P ≥ 0,05).

Table 4 : Effect of seeding depths on production parameters of oilseed *C. lanatus*

Parameters	Seeding depths		Statistics Test	
	Low	High	*F*	*P*
NFrPl	2,50±0,29[a]	1,60±0,29[b]	4,67	0,036
WFr (kg)	0,74±0,04[a]	0,70±0,05[a]	0,53	0,467
NSeFr	417,44±32,89[a]	447,37,30[a]	0,37	0,540
WGrFr (g)	25,33±2,28[a]	27,47±2,59[a]	0,38	0,541
W-100 Fr(g)	6,01±0,22[a]	6,04±0,25[a]	0,009	0,924
Yld (kg/ha)	21,66±0,42[a]	21,97±0,42[a]	0,56	0,421

NFrPl: Number of fruits per plant, WFr: Weight of fruit (kg), NSeFr: Number of seeds per fruit, WGrFr: Weight of seeds per fruit (g), W-100Fr : Weight one hundred seeds per fruit, 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 ≥ 0.05).

4. Discussion

Control of seeding depth is a fundamental step to success of all crops (O'Connor & Gusta, 1994). Thus, the study of this production factor was undertaken to improve the production of oilseed cucurbit *Citrullus lanatus*. From statistical analyzes of the three seeding depths, it was sowings realized at short depths which produced the best values of vegetative parameters. Similar results have been obtained with oilseed *Lagenaria siceraria* and others plants such as *Melilotus officinalis*, *Linum usitatissimum* (Ghaderi-far et al., 2010, Koffi et al., 2015). At this depth, the distance between the seed bed and the soil surface is very low. This implies that the thin layer of soil promotes the penetration of light, water and oxygen. According to the results of Couture (2004) environmental factors are fundamental to ensure a better development of the vegetative phase. It is also probable that the morphology of the seeds, would have contributed to obtaining such a result. Indeed, the work of Umeoka and Ogbonnaya (2016) showed that when seeds of the same size are sown at different depths, those close to the soil surface show better plant growth. According to these authors, this trend is related to the availability of the nutrient reserves contained in the seeds. Thus, in the present study, the seeds sown at shallow depths would have rationally used their nutrient reserves.

The results obtained also showed that the reproductive phase of this cucurbit is not influenced by seeding depth. This observation confirms the dependence of seeds germination and their first phase of development to nutritive reserves in the seeds. After this heterotrophic phase, the creeping of the main stem and the appearance of secondary branches stimulate the development of secondary roots at the nodes (Zoro Bi et al., 2003). In this case, the exploration of a large area for the nutrition of the plant would explain this result.

Also, sowings realized at the soil surface did not produce any results during this experiment. This suggests the need to sow the seeds of this cucurbit at optimum depth to initiate their germination and emergence. Similar results were recorded on *Melilotus officinalis* at the same depth (Ghaderi-far et al., 2010). And these results were attributed to the absence of soil contact with the seed and the insufficient amount of water needed for germination. Indeed, according to Fleury (2010) the phase of imbibition of the seeds which constitutes the first stage of the germination is dependent on the fraction of surface of the seed in contact with the earth and the water. In addition, attacks by bio-aggressors such as birds and rodents could lead to such a result. This is the case of wheat cultivation where Brown et al. (2003) noted the attacks of mice (*Mus domesticus* Rutty.) as one of the factors responsible for the low germination rate.

5. Conclusion

In order to increase production of oilseed cucurbit *C. lanatus*, investigations were undertaken in the locality of Gbokora to determine optimum seeding depth. From this study, it is only the vegetative stage that is influenced by this factor of production. The best values of these vegetative parameters were obtained on the plots with sowings realized at depth of 2 cm (low depth).

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