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Effect of Sowing Dates on the Productivity of Oilseed *Citrullus Lanatus*

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Abstract

Finding a sustainable solution to the problem of climate change is the first step to reduce food insecurity and malnutrition in developing countries. In Côte d'Ivoire the oilseed *Citrullus lanatus* constitutes a source of income for farmers. The lack of knowledge on the suitable sowing dates of this plant engenders it low production. Thus to resolve this problem, some field trial were carried out in Gbokora (Daloa). An experimental design with three blocs randomized was set up. Experimentation consisted to realize a sowing during two growing seasons: season 1 (S1) and season (S2). For each season five sowing dates separated with two weeks were realized: Early 1 (E1), Early 2 (E2), Middle (M), Later 1 (L1) and Later 2 (L2). It emerges from this study that to improve the yield of this plant, the crop should be grown during the first season. In addition, planting must be done between mid-March and the beginning of April. This period corresponds to the beginning of the rainy season in the study area. However, if the farmers wish to produce the plant in the second growing season, they will have to wait until the beginning of August, which corresponds to the short rainy season.

Keywords: Food security; climate change; sowing dates; oilseed *Citrullus lanatus*.

1. Introduction

Finding a sustainable solution to the problem of climate change is the first step to reduce food insecurity and malnutrition in developing countries. According to Chebil, *et al.* [1] climate change is the increase in temperature and the variability of rainfall. This phenomenon is a major concern for both scientists and policy makers worldwide. These climatic variations have a direct impact on agricultural production, since agricultural systems depend in part on the nature of the climate [2, 3]. This impact is particularly important in developing countries where agriculture is strictly dependent on rain without any alternative irrigation and is the main source of employment and income for the majority of the population [4, 5]. With a traditional farming system, Côte d'Ivoire is not immune to these climatic disturbances. The situation is even more alarming in a peasant environment with a continuous decline in crop production. This is particularly the case of the oilseed *Citrullus lanatus*. It is regularly grown in the North, Central West and South of the country where it occupies an important place in agricultural activities. Highly prized in Ivorian societies, roasted and dough-processed seeds are used as ingredients in sauces during traditional ceremonies such as yam festivals and end-of-year celebrations. Also the work of Loukou, *et al.* [6] showed that these seeds are very rich in lipids, carbohydrates and proteins. In addition, Zoro Bi, *et al.* [7] also showed that dried and cleaned seeds are sold at 1500 FCFA against 600 FCFA for cocoa, thus constituting an additional source of income for producers. With advantages that present of this plant, it is imperative to increase production by developing a new cultural technique. Among the existing cultural approaches, sowing date plays an essential role because it allows plants to benefit from optimum temperature and rainfall conditions. Thus, in Nigeria the work of Eifediyi and Remison [8] showed that production of *Cucumis sativus* L. increases when sowing is done at the beginning of the rainy season, clearly in the month of April. Similarly, in Iran, Shirzad, *et al.* [9] showed that early planting maximizes the production of the *Momordica charantia* L. Such information is still unavailable for the oilseed *Citrullus lanatus*. The objective of this study is to evaluate the influence of sowing date on the production of this plant. The results of this study will allow producers of this cucurbit to revise their agricultural calendar and adapt it to the new climatic conditions.

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2. Material and Method

2.1. Plant Material and Experimental Design

The planting material was constituted of 900 plants of oilseed *C. lanatus*. The seeds of those plants were obtained from the cucurbit germplasm of the University of Nangui Abrogoua (Abidjan, Côte d'Ivoire). A medium seed size cultivar (NI119) of the indigenous oilseed *C. lanatus* widely cultivated in Côte d'Ivoire was selected. Experimental design was constituted of three blocks. Those blocks were determined in an area of 0.8 hectares. Each block measured 102 m x 26 m with five plots. The plot was 16 m x 20 m containing 30 holes at depth of 3 cm. The holes were arranged in rows at spacing of 4 m between and within rows. In order to improve the growth and production of fruits five sowing dates were performed during two growing seasons (table 1). 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.

Table-1. The Treatments Realized to Estimate Sowing Dates Effects on Yield and Yield Components on Oilseed *Citrullus lanatus*

Sowing Dates
15 march : early 1 of first growing season (E1FGS)
1erapril : early 2 of first growing season (E2FGS)
15 april : middle of first growing season (MFGS)
1ermay : late 1 of first growing season (L1FGS)
15 may : late 2 of first growing season (L2FGS)
1erjune : early 1 of second growing season (E1SGS)
15 june : early 2 of second growing season (E2SGS)
1erjuly : middle of second growing season (MSGS)
15 july : late 1 of second growing season (L1SGS)
1eraugust : late 2 of second growing season (L2SGS)

2.2. Data Collection and Statistical Analysis

Yield (seeds dry weight ha) and 6 agronomical traits identified as yield components in oilseed cucurbits *C. lanatus* [10] were collected. The yield components measured included: plant vine length (PL); number of fruits per plant (NF), number of seeds per fruit (NS); seeds weight per fruit (SW); and 100-seeds weight (100-SD). Significant effect of sowing date and growing seasons were tested with ANOVA. When a significant effect is found for a 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. Determination of the Significance of Three Factors on the Performance and its Components

Table 2 shows that the year of culture factor is not significant (P = 0.291). Which means the production of this cucurbit does not vary from year to year, similarly to the year interaction of culture x date of sowing (P = 0.283). On the other hand, the crop season, sowing date and all other interactions are significant. In other words, the producer must take into account the growing season and the sowing date in order to have a better production. Since the growing year does not have a significant effect, the two-year test data were combined. Also, the two seasons being characterized by different rainfall, the sowing dates were analyzed separately. Finally, in this chapter the analysis of the results will be done according to the season of cultivation and the calendar of sowing for each season.

Table-2. Results of MANOVA Test of the Three Factors on Agronomics Parameters of the Oilseed *Citrullus Lanatus*

Factors	Statisticals	
	F	***P***
Year	1.36	0.291
Season	4.58	0.006
Sowing dates	2.90	0.040
Year x season	2.73	0.049
Year x sowing dates	1.38	0.283
Season x sowing dates	4.54	0.007
Year x season x sowing dates	2.76	0.047

3.2. Influence of Growing Seasons on Yield and Its Components

Significant differences between the growing seasons were noted for the seven characters tested (Table 3). Of the seven characters, six have high values in the first season. These are seed yield, plant length, number of fruits, fruit weight, number of seeds and seed weight. Only the weight of 100 seeds recorded its high value in the second season.

In a farm setting, parameters such as the number of fruits, the number of seeds and the yield of seeds are of interest to producers. Thus, to make a good harvest in terms of seeds and fruits, they must realize the sowing in the first season of cultivation.

Table-3. Effect of Season on yield and its Components on the Oilseed *Citrullus lanatus*

Parameters	Seasons		Statisticals	
	Season 1	Season 2	*F*	*P*
YD (t/ha)	0.25±0.16^{a}	0.10±0.04^{b}	12.15	0.002
LP (m)	4.34±1.46^{a}	3.68±1.17^{b}	51.87	<0.001
NF	11.74±8.53^{a}	5.08±3.24^{b}	204.87	<0.001
WF (g)	1241.91±534.99^{a}	1059.20±450.12^{b}	112.07	<0.001
NS	464.44±228.52^{a}	404.40±183.58^{b}	66.18	<0.001
SW (g)	25.66±14.27^{a}	23.21±11.53^{b}	28.16	<0.001
SW-100 (g)	5.33±1.16^{b}	5.66±1.01^{a}	70.83	<0.001

Mean values within column by parameter followed by the same letter (s) were not significantly different at *P*=0.05, level, on the basis of the Least Significant Difference (LSD) test

3.3. Effect of Sowing Dates on Yield and Its Components

Statistical test results from the first crop season data show a difference between the five planting dates for yield and its components (Table 4). Very early (E1FGS) and early (E2FGS) seedlings simultaneously have high yield values, plant length and number of seeds. The highest values of number and weight of fruit were obtained from early planting (E2FGS). The large seeds were produced with very early planting (E1FGS). The weight of 100 seeds has the maximum value with late sowing (E2FGS). It is retained that the producers to have a better production of this cucurbit, will have to sow either March 15th or April 1st to the first season of culture.

With the exception of yield and plant length, the other five traits completely differentiated the five sowing dates for the second crop season (Table 5). The high numbers of fruit, seed weight, weight of 100 seeds and number of seeds are from plots where planting was done very late (L2SGS). The weights of the fruits and the number of seeds have their maximum values with the sowing done very early (E1SGS).

Table-4. Effect of Sowing Dates on Yield and Its Components on the Oilseed *Citrullus Lanatus* During the First Season

Sowing Dates		Parameters						
		YD (t/ha)	LP (m)	NF	WF (g)	NS	SW (g)	SW-100 (g)
E1FGS		0.41±0.07^{a}	4.91±1.24^{a}	14.70±7.31^{b}	1377.26±496.65^{b}	525.86±194.74^{a}	30.63±12.32^{a}	5.72±0.97^{b}
E2FGS		0.40±0.11^{a}	4.88±1.30^{a}	16.93±10.55^{a}	1455.45±475.03^{a}	526.72±226.16^{a}	28.54±14.19^{b}	5.27±1.09^{c}
MFGS		0.13±0.08^{b}	4.52±1.12^{b}	10.86±6.12^{c}	841.81±362.67^{d}	307.61±183.02^{c}	14.31±9.43^{c}	4.56±1.09^{d}
L1FGS		0.11±0.09^{b}	3.10±1.29^{c}	5.10±3.02^{d}	1227.91±592.65^{c}	477.87±233.71^{b}	28.86±14.96^{ab}	5.89±1.12^{a}
L2FGS		0.11±0.06^{b}	3.46±1.56^{c}	4.75±2.65^{d}	1315.65±541.54^{bc}	502.07±237.43^{ab}	28.83±13.51^{ab}	5.82±0.99^{ab}
Statisticals	***F***	11.36	37.91	48.13	132.11	94.03	132.55	108.35
	P	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Mean values within column by parameter followed by the same letter (s) were not significantly different at *P*=0.05, level, on the basis of the Least Significant Difference (LSD) test

Table-5. Effect of Sowing Dates on Yield and Its Components on the Oilseed *Citrullus Lanatus* During the Second Season

Sowing Dates		Parameters						
		YD (t/ha)	LP (m)	NF	WF (g)	NS	SW (g)	SW-100 (g)
E1SGS		0.06±0.01^{a}	3.31±0.84^{a}	3.29±1.95^{c}	1223.64±534.50^{a}	463.01±200.11^{a}	24.63±10.80^{ab}	5.48±1.08^{c}
E2SGS		0.09±0.01^{a}	3.76±0.91^{a}	4.96±2.71^{b}	920.93±451.36^{c}	350.03±192.12^{c}	19.05±11.60^{c}	5.33±0.99^{c}
MSGS		0.10±0.02^{a}	3.77±1.10^{a}	4.92±2.98^{b}	1076.23±478.15^{b}	407.57±181.99^{b}	23.72±11.81^{b}	5.76±0.90^{b}
L1SGS		0.09±0.06^{a}	3.60±1.16^{a}	5.08±4.02^{b}	1041.19±408.53^{b}	413.48±179.32^{b}	22.57±10.83^{b}	5.35±0.99^{c}
L2SGS		0.12±0.04^{a}	3.81±1.46^{a}	6.09±3.14^{a}	1084.46±402.23^{b}	407.80±170.40^{b}	26.34±12.56^{a}	6.05±0.96^{a}
Statisticals	***F***	0.82	1.83	6.31	10.83	8.73	12.22	32.33
	P	0.546	0.123	<0.001	<0.001	<0.001	<0.001	<0.001

Mean values within column by parameter followed by the same letter (s) were not significantly different at *P*=0.05, level, on the basis of the Least Significant Difference (LSD) test

4. Discussion

Determining an appropriate planting date is fundamental to improving the production of any crop [11, 12]. Thus, the influence of sowing date on the yield and yield parameters of the oleaginous *C. lanatus* was studied during this experiment. The values of agronomic parameters tested are higher with sowing on March 15 (very early) and April 1 (early) during the first growing season. These two months mark the beginning of the rains in the study area. Under these conditions, very early and early planting benefited from the first rains of the year, favoring good germination and better plant development. Indeed, the work of Kortse and Oladiran [13] showed that when *C. lanatus* seedlings are grown during the rainy season the plants remain vigorous and give high yield. The importance of rain in the success of the culture of *C. lanatus* is also known by the farmers. The study conducted by Munisse, *et al.* [14] in three producing localities of this species in Mozambique showed that farmers plant at the beginning of the rainy season. It is the same for the producers of *C. lanatus* in Benin [15]. In addition, Nerson [16] and Erdem and Yuksel [17] showed that rain is an indispensable factor in ensuring a better yield of *C. lanatus*. Otherwise, it should be pointed out that for very early planting, the period of intense fruit setting and fruit filling occurring between the 45th

and 60th day after sowing coincides with the beginning of May [7, 18, 19]. This month is characterized by less violent rainfall, which prevents the fall of female flowers. In consequence a result, the plants were able to produce a large number of fruits containing a lot of seeds, which would have allowed relatively high yields to be recorded. When the number of fruits per plant and seeds per fruit are high in Cucurbitaceae, the yield is high [16]. The increased yield of *Brassica campestris* (L.) was explained by the high numbers of fruit per plant, the number of seeds and the weight of 1000 seeds [20]. In fact, these variables are referred to as the major components of yield for several crops [21]. Apart from yield, during this growing season, very late and late sowings recorded low values. Also, the very early and early sowing made it possible to have the best fruit weights and the number of seeds. Regarding the weight of seeds and the weight of one hundred seeds, they gave high value both with late and early sowing. This result suggests that seed quality is not influenced by the amount of fruit harvested. In other words, the plants form of oilseed *C. lanatus* would ensure their survival or reproduction by two major strategies. On the one hand during periods of stress (scarcity of rain and available resources), cucurbit adopt the R strategy, that is, they allocate all of their available resources for the perpetuation of the lineage. In these conditions, they produce very little fruit. On the other hand, they adopt the K strategy, that is to say when the environmental conditions are optimal [22]. These results could be a basis for reflection for geneticists or breeders in the search for genes resistant to drought.

During the second growing season from July to December, high yields were recorded with the late August 1 sowings. This season is less rainy and starts with the month of August [23]. The high values of the parameters could be explained by the rapid completion of the vegetative phase of the plants before the end of the rainy periods. The establishment of a dense vegetation cover during the appropriate period has created a moist microclimate at the feet of plants [24]. This moisture would have contributed to fruit development and seed filling [25]. In addition, flowering and fruiting occurs in early October when rains are less frequent, which prevents falls of female flowers. Indeed, Miah, *et al.* [26] found that torrential rains during flowering of crops lead to lower yields.

However, the yield of the first growing season is higher than that of the second growing season. The yield difference observed between the two growing seasons is related to the amount of rainfall recorded during the first growing season (516.6 mm versus 343.73 mm in the second season).

Such an observation was made by Khan, *et al.* [27] and Fatondji, *et al.* [28] on this same species. In fact, they indicated that the first growing season is more productive than the second season. In the study area, the measured parameters failed to differentiate between the two crop years. Such result was recorded by Sogut and Arioglu [29] on the plants of *Beta vulgaris*. They explained this result by the small variation of the rainfall and the temperature from one year to another.

5. Conclusion

The determination of the sowing dates is an essential phytotechnical approach that contributes to the improvement of crop production. In the farming community, lack of attention to this production factor has often led to lower crop yields. This is particularly the case for oilseed crops in rural areas in the tropics. The present study was initiated for the determination of an appropriate date of sowing of the oilseed *Citrullus lanatus*. It appears from this study that to improve the yield of this plant, the crops should be grown during the first season. In addition, planting must be done between mid-March and the beginning of April. This period corresponds to the beginning of the rainy season in the study area. However, if the farmers wish to produce the plant in the second growing season, they will have to wait until the beginning of August, which corresponds to the short rainy season.

References

[1] Chebil, A., Mtimet, N., and Tizaoui, H., 2011. "Impact du changement climatique sur la productivité des cultures céréalières dans la région de Béja (Tunisie)." *African Journal of Agricultural and Resource Economics*, vol. 6, pp. 1-9.

[2] Jerry, K., Tim, H., Andre, D., and Tim, W., 2012. "Climate change impacts on crop productivity in Africa and South Asia." *Environmental Research Letters*, vol. 7, pp. 1-8.

[3] Devi, A. P., Singh, S. M., Das, S. P., and Kabiraj, J., 2017. "Effect of climate change on vegetable production- a review." *International Journal of Current Microbiology and Applied Sciences* vol. 6, pp. 477-483.

[4] Abewoy, D., 2018. "Review on impacts of climate change on vegetable production and its management practices." *Advances in Crop Science and Technology*, vol. 6, pp. 1-7.

[5] Agossou, D. S. M., Tossou, C. R., Vissoh, V. P., and Agbossou, K. E., 2012. "Perception des perturbations climatiques, savoirs locaux et stratégies d'adaptation des producteurs agricoles béninois." *African Crop Science Journal*, vol. 20, pp. 565-588.

[6] Loukou, A. L., Gnakri, D., Djé, Y., Kippré, A. V., Baudoin, J. P., Malice, M., and Zoro Bi, I. A., 2007. "Macronutrient composition of three cucurbit species cultivated for seed consumption in Côte d'Ivoire." *African Journal of Biotechnogy*, vol. 6, pp. 529-533.

[7] Zoro Bi, I. A., Koffi, K. K., and Djé, Y., 2003. "Caracterisation botanique et agronomique de trois espèces de curcubites consommées en sauce en Afrique de l'ouest:Citrullus sp., Cucumeropsis mannii Naudin et Lagenaria siceraria (Molina) Standl." *Biotechnology, Agronomy Society and Environnement*, vol. 7, pp. 189-199.

[8] Eifediyi, E. K. and Remison, S. U., 2009. "Effect of time of planting on the growth and yield of five varieties of cucumber (Cucumis sativus L.)." *Report and Opinion*, vol. 1, pp. 81-90.

[9] Shirzad, K., Payam, M., Sayed, A. V., and Ahmad, M., 2016. "Effects of sowing date on the morphological traits and fruit yield of bitter ground." *Journal of Agricultural and Biological Science*, vol. 11, pp. 458-462.

[10] Koffi, K. K., Anzara, G. K., Malice, M., Djè, Y., Bertin, P., Baudoin, J. P., and Zoro Bi, I. A., 2009. "Morphological and allozyme variation in a collection of Lagenaria siceraria (Molina) Standl. from Côte d'Ivoire." *Biotechnology, Agronomy, Society and Environnement*, vol. 13, pp. 257-270.

[11] Troiani, R. M., Sanchez, T. M., Reinaudi, N. B., and Ferramola, L. A., 2004. "Optimal sowing dates of three species of grain-bearing amaranth in the semi-arid Argentine Pampa." *Spanish Journal of Agricultural Research*, vol. 2, pp. 385-391.

[12] Gholami, S., Hosseini, S. M., and Sayad, E., 2007. "Effect of soil, sowing depth and sowing date on growth and survival of Pistacia atlantica seedlings." *Pakistan Journal of Biological sciences*, vol. 10, pp. 245-249.

[13] Kortse, P. A. and Oladiran, A. J., 2013. "Effects of season, time of fruit harvesting and after- ripening durations on the quality of egusi melon [Citrullus lanatus (Thunb.) Matsum and Nakai] seed." *International Journal of Scientific and Research Publications*, vol. 3, pp. 1-10.

[14] Munisse, P., Andersen, S. B., Jensen, B. D., and Christiansen, J. L., 2011. "Diversity of landraces, agricultural practises and traditional uses of watermelon (Citrullus lanatus) in Mozambique." *African Journal of Plant Science*, vol. 5, pp. 75-86.

[15] Achigan-Dako, G. E., Fagbemissi, R., Avohou, H. T., Vodouhe, R. S., Coulibaly, O., and Ahanchede, A., 2008. "Importance and practices of Egusi crops (Citrullus lanatus (Thunb.) Matsum. & Nakai, Cucumeropsis mannii Naudin and Lagenaria siceraria (Molina) Standl. cv. (Aklamkpa) in sociolinguistic areas in Benin." *Biotechnology, Agronomy Society and Environnement*, vol. 12, pp. 393-403.

[16] Nerson, H., 2007. "Seed production and germinability of cucurbit crops." *Seed Science and Biotechnology*, vol. 1, pp. 1-10.

[17] Erdem, Y. and Yuksel, A. N., 2003. "Yield response of watermelon to irrigation shortage." *Scientia Horticulturae*, vol. 98, pp. 365-383.

[18] Achigan-Dako, G. E., Fanou, N., Kouke, A., Avohou, H., Vodouhe, R. S., and Ahanchede, A., 2006. "Evaluation agronomique de trois espèces de egussi (cucurbitaceae) utilisées dans l'alimentation au Benin et élaboration d'un modèle de prédiction du rendement." *Biotechnology, Agronomy, Society and Environnement*, vol. 10, pp. 121-129.

[19] Friesen, G. H., 1978. "Weed interference in pickling cucumbers (Cucumis sativus)." *Weed Science*, vol. 26, pp. 626-629.

[20] Bhuiyan, M. S., Mondol, M. R. I., Rahaman, M. A., Alam, M. S., and Faisal, A. H. M. A., 2008. "Yield and yield attributes of rapeseed as influenced by date of planting." *International Journal of Sustainable Crop Production* vol. 3, pp. 25-29.

[21] Svecnjak, Z., Varga, B., and Butorac, J., 2006. "Yield components of apical and subapical ear contributing to the grain yield responses of prolific maize at high and low plant populations." *Journal of Agronomy and Crop Science*, vol. 192, pp. 347-342.

[22] Grime, J. P., 1977. "Evidence for the existence of three primary strategies in plants and its relevance to ecological and evolutionary theory." *The American Naturalist*, vol. 111, pp. 1169-1194.

[23] Kouassi, N. J. and Zoro Bi, I. A., 2009. "Effect of sowing density and seedbed type on yield and yield components in bambara groundnut (Vigna Subterranea) in woodland savannas of Côte d'Ivoire." *Experimental Agriculture*, vol. 46, pp. 99-110.

[24] Bond, W. and Burston, S., 1996. "Timing the removal of weeds from drilled salad onions to prevent crop losses." *Crop Protection*, vol. 15, pp. 205-211.

[25] Wang, Y. J., Xie, Z. K., and Li, F. M., 2004. "The effect of supplemental irrigation on watermelon (Citrullus lanatus) production in gravel and sand mulched fields in the Loess Plateau of northwest China." *Agricultural Water Management*, vol. 69, pp. 29-41.

[26] Miah, A. K., Anwar, P., Begum, M., Shukor, A., Juraimi, H., and Islam, A., 2009. "Influence of sowing date on growth and yield of summer mungbean varieties." *Journal of Agricultural and Social Sciences*, vol. 5, pp. 73-76.

[27] Khan, A. Q., Iqbal, M., Jilani, S., Ghaffoor, A., and Waseem, K., 2001. "Effect of different sowing dates on yield of tinda gourd (Citrullus vulgarus) var fistulosus under the agroclimatic conditions of D. I. Khan." *Journal of Biological Sciences*, vol. 1, pp. 235-237.

[28] Fatondji, D., Pasternak, D., and Woltering, L., 2008. "Watermelon production on stored rainwater in sahelian sandy soils." *African Journal of Plant Science*, vol. 2, pp. 151-160.

[29] Sogut, T. and Arioglu, H., 2004. "Plant density and sowing date effects on sugarebeet yield and quality." *Journal of Agronomy*, vol. 3, pp. 215-218.