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ORGANIC COTTON FARMING: EXPLORING PLANTING RATES FOR SUSTAINABILITY AND YIELD

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Abstract: In this work, conventional cotton was planted with two densities of 8 and 14 plants/linear m, with organic management on certified organic crop land. The results obtained were between 3.8 and 3.4 t/ha, with an average of 12.6 cocoons with a density of 8 plants/linear m and 8.6 cocoons with 14 plants. During the development of the crop, there were no pest insects that affected the cotton. however, two preventive applications of natural extracts of neem, cinnamon and castor were made.
Keywords: conventional, performance, production

INTRODUCTION

Cotton (G. hirsutum L.) is considered one of the most important non-food crops in the world (SAGARPA and FAO, 2014) and represents 30% of the fibers used worldwide (FAO, 2018); it is cultivated in more than 50 countries (Vinent and Fajardo, 2007). G. hirsutum and G. barbadense are the species that contribute more than 99 % of the world supply (Ashraf, 2002), and of these two, Gossypium hirsutum, is the one that is most cultivated worldwide due to its high quality fiber in fabric manufacturing (Pérez et al., 2011; Poelham and Allen, 2003).

Cotton is a plant native to tropical countries, however, its cultivation has spread throughout the world thanks to advances in cultivation techniques and the appearance of new varieties. Cotton plantings are based on the use of transgenics, which began in 1996 and in 2010, with the companies that generated the technological packages that obtained permits for their commercial cultivation.

Conventional cotton production has been associated with the extensive use of agricultural crops and the application of chemicals, leading to environmental and health problems, and decreased effectiveness of pesticides. The United States Department of Agriculture shows that pounds of glyphosate used in growing conventional cotton nationally doubled between 2011 and 2019, and acres of conventional cotton treated with pesticides increased by 38.2% (Department of Agriculture, 2020). For this reason, new alternatives such as organic agriculture have been implemented to face the problems that derive from the use of transgenics and with this, exploring new markets. Nahed et al. (2009) mention that organic agriculture bases its principles on agroecology. In general terms, the authors describe the environmental impact, as well as man's concern about the quality of the food he consumes, as a result of conventional agricultural activity, which has given rise to the implementation of environmentally friendly agricultural production systems, whose generic name is organic agriculture (Moreno et al., 2009) Demand for organic cotton is growing and several studies have found that consumers are willing to pay premium prices for organic cotton (Casadesus-Masanell et al., 2009; Ellis et al, 2012). Organic fiber has shown the largest and fastest growth in the non-food organic sector, which has led to a rapid increase in Global Organic Textile Standard (GOTS) certified facilities.

Organic cotton is currently attracting a lot of attention after its impressive growth in recent years, Organic Exchange, (2008), Ferrigno, (2008), mentions that ways must be found to guarantee the sustainability of production systems in moments of growth, which in turn implies identifying and analyzing the components of a system free of agrochemicals. Eliminating the use of dangerous pesticides, lower production costs, and environmental safety are some of the reasons growers have embraced organic cotton. However, the production of organic cotton has low yields, since the elimination of the two main inputs, namely insecticides and synthetic fertilizers, prevents the plant from developing its full potential (Devine et al., 2008). Based on the above, the objective of this work is to evaluate the yield of cotton crops with organic management and with two planting densities as an alternative in the search for new markets that demand environmental sustainability.

MATERIALS AND METHODS

The experiment was carried out during the 2022 agricultural cycle on land of the Norman E. Borlaug Experimental Field belonging to the National Institute of Forestry, Agriculture and Livestock Research, located in block 910 of the Yaqui Valley, Sonora, at coordinates: 27°22’ 16.43´´N, 109°55´15.39´´W. Its average height above sea level is 40 meters in a clay-textured soil with a pH of 7.8. The climate of the region, according to the Koppen classification and modified by Enriqueta García, corresponds to dry warm (type BW) and dry very warm semi-warm (type BSo). The average precipitation in the year is around 280 mm of which 75% occurs in the summer months (June to October) in the form of torrential rains and the remaining 25% occurs in the winter months (November to March) with slow rains (Jauregui and Cruz, 1980). This work was carried out on land certified for organic crops since 2017 (AGRICERT MEXICO–SENASICA, 2019; BIOAGRICERT, 2019a, b); The germplasm used was the conventional Sure Grow 105 from the Delta and Pine company, with a planting date of March 17, 2022, at densities of 8 and 14 plants/linear m at a depth of 7 cm, in beds of 100 m of depth. length at a separation between furrows of 1m. Prior to planting, the land was prepared with three rakes and leveling. In this work, five irrigations were carried out, fertilization was carried out with 2500 kg/ha prior to the three first aids with the product bida from the company DASA (figure 1). The management of pests and diseases was monitored with yellow sticky traps, for the control of sucking insects two preventive applications were made with extracts of neem, cinnamon and castor. For the management of weeds, a cultivator and manual weeding with the use of daily labor were used (figure 2). The cotton yield in bone and feather was evaluated. Cotton bone is made up of the seed and the feather. And the feather yield is obtained after separating the seed. Yield components such as the number of cocoons per plant, cocoons weight, number of seeds per cocoon, weight of 100 seeds and fresh weight of the plant were evaluated. The experimental unit was 10 m. linear with three samplings per density.

Figure 1. Organic fertilization in cotton cultivation

Figure 2. Manual and mechanical weeding in organic cotton cultivation

RESULTS AND DISCUSSION

In the evaluation of the two planting densities in cotton cultivation with organic management, it was identified that a higher yield was obtained at 8 plants/linear m, equivalent to a gain of 11% compared to the yield obtained with a density of 14 plants/m linear. Having made three applications of fertilizer prior to each irrigation during the

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three first aids, we consider that there was no need to apply phosphorus as required by the plant on late planting dates due to the considered high yield. Devine et al., (2008) mention that the sowing of organic cotton generates low yields, due to the lack of agrochemicals, so it is difficult to cover the needs for optimal development of the plant, which is observed to be of low size and lack of foliage with an average height of one meter in both densities. However, the highest number and weight of cocoons was obtained in the lower density sowing with an average of 12.6 cocoons/plant, which meant 4 cocoons more than when sowing with high density. This resulted in a higher yield, due to the retention of cocoons, this represents greater weight, as mentioned by Gil et al., (2003). Sánchez et al., (2007) coincide with what was observed in this work, since as the population density increases, the number of flowers and buds decreases, as shown in table 1. The weight of 100 seeds was higher when sowing with higher density. The low density confirms what is recommended at the commercial level, which suggests planting 5 to 8 plants/linear m. Lopez et al., (2014) In one of their works, they mention that an adequate dose of manure is more efficient than a chemical fertilization based on nitrogen and phosphorus, but the key is to find the balance in organic applications. A point to highlight is that during the development of the crop there was no presence of pests that affected yield. The use of organic type fertilizers accelerates root development and the physiological processes of sprouting, flowering, maturity and color. By improving the general condition of the plants, their resistance to attack by pests and pathogens increases.

CONCLUSIONS

Due to the high costs of fertilizers, other alternatives are sought that contribute to generating more economic benefits for the producer, implementing organic agriculture is a potential market that is constantly growing, the countries considered developed are the ones that raise their hands towards this type of products, due to the high purchasing power and the search for a healthier lifestyle in harmony with the environment. Future prospects for organic cotton cultivation are promising. As the demand for environmentally friendly and sustainable agricultural products continues to rise, the adoption of organic practices is expected to continue to grow. This trend will be supported by research and innovation in management methods and technologies that maximize the benefits of this practice. However, it is important to recognize that growing organic cotton also faces challenges, such as efficient pest and disease management, as well as the need for further training and technical assistance for farmers wishing to transition to organic practices.

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Rep*	Density	Bone	Feather	AdP*	PdP*	NCPP*	PdC*	NSPP*	P100S*
1	8	3810	1449	102	698	12	77	32	9.56
2	8	3934	1484	105	684	11	75	38	9.07
3	8	3747	1482	94	556	15	101	33	9.75
Half		3830	1471	100	645	13	84	34	9.46
CV		0.024	0.013	0.056	0.121	0.165	0.170	0.093	0.037
1	14	3505	1340	105	314	8	72	35	9.40
2	14	3428	1389	93	422	9	71	29	9.62
3	14	3297	1442	96	346	9	71	32	9.93
Half		3410	1390	98	360	9	71	32	9.65
CV		0.030	0.036	0.063	0.153	0.066	0.010	0.093	0.027

Table 1. Average of the variables evaluated in low densities through organic management of cotton.

CV= coefficient of variation, Rep= repetition, Adp (cm)= plant height; PdP (g)= plant weight; NCPP= cocoon number; PdC (g)= cocoon weight; NSPP= number of seeds per plant, and P100S (g)= weight of 100 seeds.

Figure 3. Organic cotton material sure grow 105 delta pine