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Evaluating the Yield Performance of Eight Cotton Improved Varieties with Two Local in the Agro-Ecological Zone Western, Kandahar

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ABSTRACT

Cotton (Gossypium hirsutum L.) is a crucial crop that produces fluffy fiber essential for the global textile industry. Cottonseed is also a valuable raw material for oil and feed industries due to its high protein content. This study compared nine varieties (Namken, Agosta, N726, Turkish, CD-401, Acala 151799, Blanka, Paloma, and Acala 1517-75) with two local standard cultivars (F-108 and Acala) to identify highly adaptable and sustainable varieties for regional and global markets based on yield performance. The trial was conducted in 2018 at the Kokaron research farm in Kandahar, a semi-arid region. The experiment was established by ARIA using a randomized complete block design with four replications, with each plot measuring 12 m². Results revealed that Agosta produced the highest cottonseed yield, followed by Namken. Furthermore, Agosta achieved the highest total yield, with Namken, Blanka, Paloma, and N726 following in descending order among all tested varieties. Fiber length varied significantly among all varieties under investigation. In conclusion, eight varieties (Agosta, Namken, Blanka, Paloma, N726, Turkish, Acala 151799, and CD-401) demonstrated higher economic production compared to the regional standard varieties, with Agosta emerging as the most promising variety for the research area.

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Introduction

The cotton plant, *Gossypium hirsutum* L., belongs to the family Malvaceae. It is a boll surrounding seeds or a soft, fluffy staple fiber protective shell. Globally, tropical and subtropical climates are habitats for the cotton plant, a shrub. Cotton is cultivated in approximately 76 countries, spreading more than 32 million hectares, with a wide range of environmental circumstances globally, and the global cotton marketplace is valued at nearly US$20 billion a year (Saranga *et al*., 2001). Cotton, the crop of commerce, production, history, and civilization, is receiving attention once again on an international basis due to its

silver fiber (Salman *et al*., 2011) and because of the world's substantial amount of seed oil and protein; its seed is an important ingredient for the oil and feed industries (Ehsan *et al*. 2008).

By classifying several appearances, physiological and quantitative yield components or plant features, including height, form, fruiting type, and boll weight, cotton breeders are increasing the production of seed cotton (Sharma *et al*.,2021), (Bollester *et al.,* 2021), (Kumar *et al*., 2000) and (Razzaq *et al.,* 2021). The main objective of cotton researchers is to discover new, improved cotton varieties with superior combinations of desirable quantitative and qualitative plant characteristics through history selection, gene accumulating techniques, and genetics. The result will increase the amount produced per unit area (Zamir, 2001). Hence, cotton is the main cash crop in Afghanistan; agricultural scientists have made it their constant purpose to produce beneficial, sustainable cotton varieties for both the domestic and global markets. This is an agronomist's responsibility. Complaints from farmers about low yield and low-quality varieties of local cotton will be planned and implemented.

This research aims to compare two local and eight foreign varieties to find high-yielding cotton varieties with the environmental conditions, recommend the best varieties based on yield performance in the southern zone and related traits and choose well-being sustainable varieties for regional and global markets.

Methods and Materials

In this study, eight cotton varieties (Namken, Agosta, N726, Turkish, CD-401, Acala 151799, Blanka Paloma, and Acala 1517-75) were compared with two standard control varieties (F-108 and Acala), varieties were created in dissimilar foreign countries. The local variety was obtained from the agricultural research farm of Helmand province, where the research was carried out. It is considered the usual agricultural species of the mentioned province. The trial was carried out in 2018 at Kokaron Research Farm under semi-arid conditions in Kandahar. It was utilized to set up the Legume and Industrial Crop Department on the vertigo of the Agricultural Research Institute of Afghanistan (ARIA). In the randomized complete block design with four replications, all the varieties were cultivated in four rows with a length of 5 meters and 60 * 25 cm2. The growth parameters at the maximum flower stage and yield and yield components were collected three times at ten-day intervals at harvesting time.

The ten plants were randomly selected from the middle of two rows for sampling. All data on growth except yield was collected from these plants. At the harvesting time, two middle rows of 4 meters were harvested. Before planting the crops, phosphorus (P_2O_5) was used in the seedbed preparation process at a rate of 80 kg ha^{-1}. Additionally, two splits received an equal application of 115 kg ha^{-1} nitrogen. All aspects of agricultural performance, such as plant protection and irrigation, were the same for every treatment. The ANOVA software in SPSS analyzed the collected data. Duncan's multiple comparison test was used after a one-way analysis of variance (ANOVA) to examine any significant differences between the groups. For each variable, a significance level of 0.01 and 0.05 was established. The analysis results were presented as the mean ± standard error of the mean (SEm).

Results and Discussion

There were significant differences in the plant heights of different varieties. The Acala 151799 plant grew higher with an average plant height of 103 cm, which was statistically comparable to improved income varieties such as Blanka Paloma, Turkish, and the locally cultivated varieties F-108 and Acala (99.5, 92, 94, and 95.25 cm), respectively. The lowest plant height of CD-401 was 80.25 cm, the same as Agosta, Namken, N726, and Acala 1517-75 (84.5, 83.5, 83.5, and 83.5 cm, respectively). The results of this study's investigation on plant height agreed with those of the previous research. The longest variety, Agdas-6, measured 109.15 cm in the last study that claimed the maximum plant height of 159 cm. However, the study also found that environmental factors and growing conditions influenced plant height. Agdas-7 (103.61 cm), Agdas-3 (103.21 cm), and Maras-92 (103.78) cm. Furthermore, with 87.12 cm, the shorter variant was Stoneville-453 (normal variety). Basbag & Temiz (2004) described comparable results (89.46 to 90.44 cm). As indicated by (Hanif *et al.,* 2005) & (Efe *et al.,* 2013).

The findings showed highly significant differences between varieties in the number of bolls plant^{-1}. Blanka Paloma had a higher number of bolls per plant (75.5) than Agosta and Acala 151799 (66.75 and 66.5), respectively. The lowest number of bolls (30.25) was produced by CD-401, which was far from Namken, Turkish, F-108, and N726 (65.25, 64.5, 54.5 & 44.75), and the same was true for the Acala 1517-75 and Acala (34.25 and 33.25), respectively. Blanka Palom generated the maximum number of bolls (75.5 plant^{-1}), whereas CD-401 produced the lowest number of bolls (30.25 plant^{-1}). The results from the study show that the number of bolls per plant differs significantly from previous research; this variation could be due to the favorable climate. (Efe *et al.,* 2013) revealed that Agdas-17, with 15.41 bolls per plant, had the highest number; Agdas-6 (15.39), Agdas-7 (14.97), and Agdas-3 (14.56) had the following highest numbers. At 11.79, Maras-92 had the smallest number of bolls per plant. The maximum number of bolls per plant has been determined to be 33.2, 54 to 59, 40.2 to 52.1, and 36 by (Singh *et al.,* 2008), (Hanif *et al.,* 2005), (Hassan *et al*., 2007) and (Arshad *et al*., 2003), respectively. Boll numbers for each plant correlate to the sympodial number and plant height. Researchers discovered that the cultivar with the largest sympodial number exhibited the largest boll. The total number of bolls per plant varied between 11.22 and 25.85, as reported by (Soomro *et al.*, 2005).

The results showed that the number of seeds boll^{-1} was significantly different among all varieties. The highest number of seed boll^{-1} attained from Acala 151799 (33.5) seeds boll^{-1} was the same for Acala 1517-75, N726, and Agosta (31.25, 30.75 & 30.25) and the lowest number of seed boll^{-1} obtained from Namken was 27.25 and it was the same Turkish, CD-401, Acala and F-108 (27.25, 28.25, 28.5 &27.5) respectively. According to (Efe *et al.,* 2013), earlier research indicated that the weight of cottonseed in each boll of different varieties varies from 4.82 g (Sayar-314) to 4.14 g (Stoneville-453). The findings (5.6 to 5.7 g, 4.9 to 5.7 g, 4.6, 4.34, and 4.20 g, respectively) were published by (Begum and Hossain, 2011) (Begum *et al*., 2005) (Hanif et al., 2005), (Arshad *et al.,* 2003), also (Ashokkumar and Ravikesavan, 2011). Similarly,

(Soomro *et al*., 2005) found 3.07 to 3.30 g of cottonseed per boll. The results of the study, which are consistent with earlier research, indicate that there are differences in the number of seeds per boll. Depending on the varieties, the number of seeds in each boll varies. The mean findings for various varieties were comparable; Namken contains the least cottonseeds per boll (27.25), and only Acala 151799 has a higher number of cottonseeds boll^{-1} (33.5) than the standard variety.

Our results showed that fiber length was significantly different among the varieties. The longest fibers were obtained from Namken (2.98 cm) followed by Agosta (2.95 cm), and same for Blanka Paloma, Acala 1517-75, F-108 and Turkish and Acala (2.83, 2.80, 2.70, and 2.68 cm) besides the lowest fiber length was obtained from the acala (2.63 cm) followed by N726, CD-401, and Acala 151799 (2.43, 2.63, 2.58 and 2.58 cm) respectively. According to the (Efe *et a*l., 2013) study, the Sayar-314 variety had the longest fiber, measuring 29.90 mm, while the other varieties' fiber lengths were comparable (Arshad, 2003). In addition, in a different study, the longest fibers measured 28.13 mm, followed by 26.43 mm. According to (Basbağ and Temiz, 2004), the longest fiber was determined to be 30.02 mm. Nevertheless, longer fibers of 32.33 mm were obtained, as reported by (Karademir *et al*., 2010). However, scientists also stated that the advanced cotton strains used in the study were obtained from a cotton development program. Long fibers of 32.90 mm were found to be received by (Ashokkumar and Ravikesavan, 2011).

Study results showed that all the kinds' seed weights varied significantly. The highest 1000 seed weight was Agosta (119.75 g), followed by Namken, N726, Acala 151799, and Turkish (111.98, 111.75, 111.65 & 111.05 g). Still, the lowest thousand seed weight was obtained from the locally cultivated variety Acalla (102.8 g), which was the same as the Blanka Paloma, F-108, CD-401, and Acala 1517-75 (106.5, 106.35, 105.3, and 103.9 g) respectively. As reported by (Efe *et al*., 2013), Sayar-314 (11.07 g), Agdas-17 (10.87 g), Agdas-7 (10.71 g), and Maras-92 (10.58 g) produced the greatest 100 seed weights. The last 100 seed weights (9.42 g) were determined from Stoneville-453 and presented similar results (10.44 g) by (Ashokkumar and Ravikesavan, 2011).

The investigation results, which are illustrated in (Figure 1), showed significant differences in fiber weight among all varieties. The highest fiber weight was recorded in Agosta (0.57 ton ha^{-1}), followed by Namken, Blanka Paloma, N726, and Turkish (0.53, 0.51, 0.50, and 0.43 ton ha^{-1}). Moreover, the lowest fiber weight was recorded in Acala 1517-75 (0.24-ton ha^{-1}), which was statistically similar to Acala 151799, CD-401, F-108, and Acalla (0.39, 0.32, 0.31 and 0.31 ton ha^{-1}), respectively. This finding agrees with the following results (Shah and Rasheed, 2016). Concerning a study, there were variations in the total lint weights of the cotton varieties. CEMB-33 (46 g) and IR 3701 (42 g) had the heaviest total lint weights, while FH-113 (32.3 g) had the lowest values of this parameter. (Khan *et al*., 2005) reported significant differences in lint percentage among different cotton cultivars; (Hussain *et al*., 2007) and (Bechere *et al*., 2011) also reported this, and (Khan *et al*., 2017) reported significant differences in total lint weight.

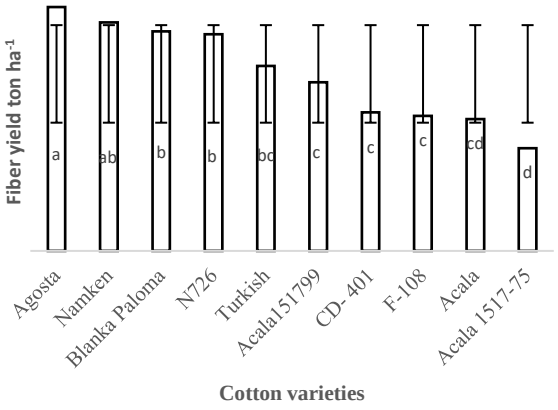

Figure 1: Fiber yield ton ha^{-1}.

The investigation results showed considerable differences in each variety's capacity to produce seeds (Figure 2). The highest seed yield was obtained from Agosta (2.438 ton ha^{-1}), followed by Namken, Blanka Paloma and N726 (2.051, 1.900 & 1.887 ton ha^{-1}) and the last seed production was recorded from Acala 1517-75 (1.094 ton ha^{-1}) statistically similar to the Acala 151799, Turkish, F-108, CD-401 and Acala (1.541, 1.539, 1.429, 1.381 & 1.281 ton ha^{-1}) respectively. Agdas-17 (3654.2 kg ha^{-1}), Agdas-3 (3593.8 kg ha^{-1}), and Stoneville-453 (3033.7 kg ha^{-1}) had the lowest cottonseed production, as determined by (Efe *et al.,* 2013). (Begum and Hossain's, 2011) observed cottonseed production (2634 and 2632 kg ha^{-1}) rarely differ from our findings. According to (Copur, 2006), the cottonseed produced ranged from 1884 to 4322 kg h^{-1}. Furthermore, the cottonseed production of (Basbağ and Temiz, 2004) and (Arshad *et al.*, 2003) was comparable to ours. (3907.5 kg ha^{-1} and 2896-3026 kg ha^{-1}). In addition, higher cottonseed production was recorded by (Hassan *et al.*, 2007) (5095–5417 kg ha^{-1}) and (Hanif *et al.,* 2005) (4294–4629 kg ha1). Similarly, a larger production of cotton seeds (4087 kg ha^{-1}) was observed by (Karademir *et al.*, 2010) than the mean results for the last four years.

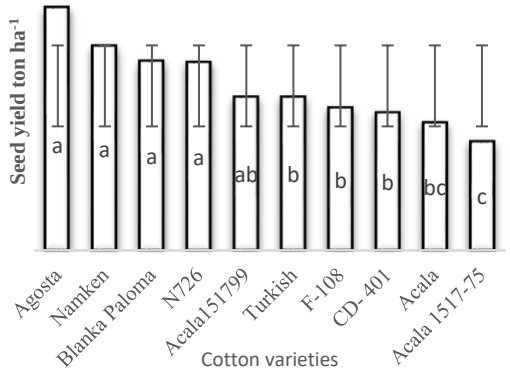

Figure 2: Seed yield ton ha^{-1}

The cottonseed production of Agosta was higher than standard varieties, followed by Namken, Blanka Paloma, and N726. These varieties produce greater sympodial and boll

numbers than ordinary variations, which could be the cause. Arguably, the most promising varieties for this region are Agosta, followed by Namken, Blanka, Paloma, and N726 (2.051 gave a higher cottonseed production of 2.438 ton ha^{-1}) than local F-108 and Acala with higher cotton seed yields; Agosta gave a higher cotton seed yield of 1.01 and 1.157 ton ha^{-1} respectively. Factors associated with the environment and genetic variations influence variations in production. Cottonseed yield, also known as ginning outturn, is a quantitative heredity influenced by multiple gene pairs and expressed as the ratio of lint to seed cotton. The Turkish variety had the highest winning percentage at 28.95%, while the lowest was recorded at 23.05% in the F-108. In the study by (Effie *et al.,* 2013), conventional cultivars (Sayar-314 and Stoneville-453) provided the highest ginning outturns, with Agdas-17 (39.96%), Agdas-3 (39.27%), and Agdas-6 (38.68%) following in order of decreasing ginning outturn: Agdas-7 verity (38.39%) and that was because of their higher 100-seed weight.

Conclusion

Following the study's discoveries, cultivars differ significantly, according to statistical analysis of the traits examined, including seed production, fiber weight, and length. Additionally, the findings showed that while the boll number per plant was highly significant, the varieties were statistically significant for plant height, seed number per boll, fiber length cm^{-1}, 1000 seed weight g^{-1}, fiber weight ton ha^{-1}, and seed weight ton ha^{-1}. The varieties with the most bolls per plant were Blanka Paloma (75.50). Agosta produced the greatest quantity of cottonseed (2.438 tons ha^{-1}), while Namken came in second (2.051 tons ha^{-1}). Among the tested varieties, Agosta had the highest total yield (3.004 tons ha^{-1}), followed by Namken, Blanka Paloma, and N726 (2.581, 2.410 & 2.391 metric tons ha^{-1}), respectively. The most promising varieties for Afghanistan's cotton-growing regions are Agosta, Namken, Blanka Paloma, N726, Turkish, Acalla151799, and CD-401, which ranked in order of higher cotton economic production in comparison to local standard varieties (figure 3).

Varieties are recommended based on their quantitative characteristics. Since the quality of cotton is also considered from an economic point of view, it is necessary to check the quality of the cultivars studied and presented.

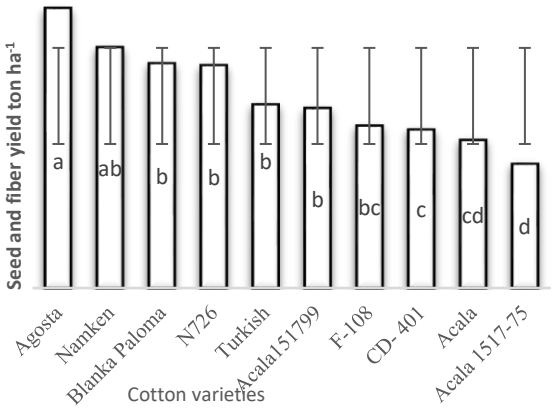

Figure 3: Cotton economic yield ton ha^{-1}.

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