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Research Article

Breeding and Agro Morphological Performances of Onion Varieties in Rainy Season in Côte d'Ivoire

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Abstract

Background and Objective: In Côte d'Ivoire, onion is generally grown in the dry season. To remedy this situation, it is necessary to provide farmers with varieties adapted to the rainy season in order to improve national production. Hence, the objective of this study was to assess the agronomic and morphological potential of two onion varieties adapted to the rainy season. **Materials and Methods:** The agromorphological performances of the onion varieties Ares and Prema in the rainy season were studied in comparison with the control Violet de Galmi, a variety widely grown in Côte d'Ivoire. To achieve this, plant loss rate, plant height, number of leaves of the plants and bulb yield variables have been submitted to an analysis of variance and comparison of average. **Results:** The plant loss rate of 92.88% for Violet de Galmi and rates of 20.29 and 38.75%, respectively for Ares and Prema. The latter varieties have had the most developed plants with average heights of 57.90 cm (Ares) and 63.13 cm (Prema) for an average production of 12 leaves. Violet de Galmi had an average plant height of 42.86 cm and produced eight leaves. The mass of the bulbs has been higher in Prema (58.27 g) and Ares (58.23 g) than in Violet de Galmi (27.55 g). Ares yielded an average of 24.17 ton of bulbs per hectare. Prema yielded 18.61 ton. Violet de Galmi recorded the lowest yield (2.06 ton). **Conclusion:** In view of these results, the varieties Ares and Prema can be recommended for rainy season cultivation in the North of Côte d'Ivoire.

Key words: Onion, selection, rainy season, improvement, productivity, Côte d'Ivoire

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Onion cultivation has good economic prospects with annual productions estimated around 100 million tons¹. In West Africa, onions are one of the most consumed vegetables². This crop has been the subject of increased production for the past 20 years in various Sub-Saharan African countries. This growth corresponds to the development of dry-season gardening, a strategy to catch up with poor rainy season agricultural campaigns and to a diversification of income sources³.

National onion production in Côte d'Ivoire is 8,000 ton. Ivory Coast is one of the smallest onion producers in the sub-region. However, it has significant production potential both in the savannah zone and in the forest zone⁴. To make up the deficit, Ivory Coast imports more than 100,000 ton of onions each year, or 30,000,000,000 CFA francs, which represents a shortfall for the country's domestic needs.

Ivorian producers generally grow onions during the dry season, with the result that Ivorian onions tend to be in short supply on the market after the rainy season. To enable farmers to extend onion production throughout the year and to make Côte d'Ivoire self-sufficient, the provision of varieties adapted to different seasons would be one of the solutions. It is with this in mind that this study, which forms part of a project of selection of onion varieties for different Ivorian agro-climates, has been initiated.

The main objective of this study was to improve onion production and productivity in Côte d'Ivoire by making selected varieties available to growers. The specific aim was to assess the agronomic and morphological potential of two onion varieties adapted to the rainy season.

North of Côte d'Ivoire. The site is characterized by a tropical Sudanese-Guinean climate, marked by two main seasons. A rainy one that extends from May to October and a dry season from November to April. The average annual temperature is 27°C and the average rainfall is about 1200 mm/year. This study was conducted from May to October 2021.

Plant materials: The plant material consists of two onion varieties evaluated, ARES and PREMA and Violet de Galmi variety used as a control. Violet de Galmi is the most popular variety in Côte d'Ivoire. The PREMA was taken in Mali and ARES is a new variety sold in Côte d'Ivoire.

Experimental design: Confection of beds measuring 6 m × 1 m × 15 cm (L × W × H), i.e., 6 m² on a height of 15 cm (Fig. 1). The beds are 01 m apart and the blocks are 2 m apart. After 40 days in the nursery, the plants have been transplanted onto the beds. On each bed, the spacing between the rows has been 10 cm and on each row the plants were spaced 15 cm apart, i.e. a spacing of 10 × 15 cm, resulting in a density of 40 × 10 = 400 plants/bed.

Data collection: Two months after transplanting, the number of plants present was counted per bed for each variety. Then 10 plants were randomly sampled per bed, i.e., 30 plants for each onion variety, to assess morphological characteristics such as plant height and number of leaves per plant. At harvest, the number of bulbs has been counted and weighed per bed and per variety. The bulb yield per bed of six square meters and per hectare has been calculated. The rate of loss of the individuals was calculated by making the report number of individuals on the board at the time of the count by the number of individuals at the start, which was 400. This ratio was multiplied by 100.

MATERIALS AND METHODS

Study site: The trial was conducted on the experimental site of the University Peleforo Gon Coulibaly in Korhogo, in the

Statistical processing of the data: The data collected were subjected to an analysis of variance followed by the

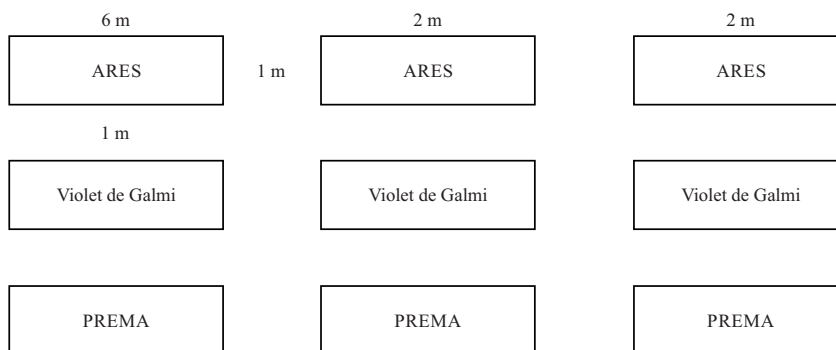


Fig. 1: Experimental design of the trial

post-ANOVA test of Newman and Keuls at 5% probability level, using SPSS version 22.0 statistical software.

RESULTS

Vegetative characteristics: Two months after planting, Ares and Prema lost 7 and 14% of plants, respectively (Fig. 2a). At the same period, the control Violet de Galmi lost around 73% of its plants (Fig. 2b). At maturity, the loss rate has been higher in Violet de Galmi (93%) than in Prema (38.75%). Ares had the lowest loss rate (20.29%) (Fig. 3).

At the level of vegetative characteristics, the varieties Ares and Prema performed better (Table 1). Plants of the variety Prema were the tallest (63.13 cm), followed

by those of Ares (57.90 cm). Galmi Violet had the lowest height (42.86 cm). Ares and Prema produced an average of 12 leaves, while Violet de Galmi produced an average of eight leaves.

Per bed of 6 m², the variety Ares produced an average of 319 bulbs compared with 245 and 29 for Prema and Violet de Galmi respectively (Fig. 4). The mass of the bulbs was higher in Prema (58.27 g) and Ares (58.23 g) than in Violet de Galmi (27.55 g) (Fig. 5).

The yield in bulbs for a bed of 6 m² was 15.5 and 11.17 kg for the varieties Ares and Prema, equivalent to 24.17 ton of bulbs per hectare for Ares and 18.61 ton for Prema (Fig. 5). Violet de Galmi recorded the lowest yield of 1.23 kg for a bed of 6 m² and 2.06 ton ha⁻¹.



Fig. 2(a-b): Varieties of (a) Bed with ARES and (b) Bed with Violet de Galmi two months after transplanting

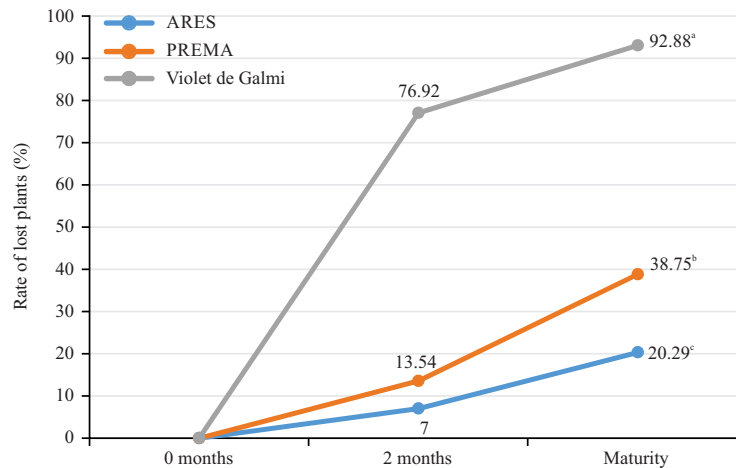


Fig. 3: Trends in plant loss rates for onion varieties in the field

NB: Rates indexed by the same letter are not significantly different (Newman-Keuls test at 5 %)

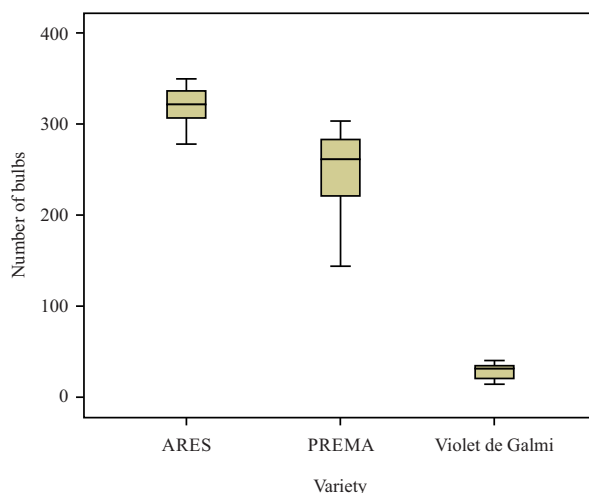


Fig. 4: Average number of bulbs produced per variety per bed 6 m²

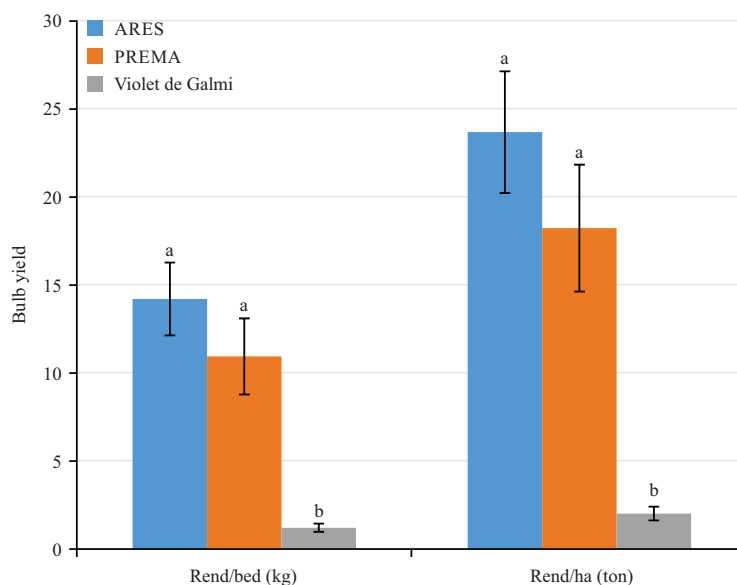


Fig. 5: Yield per bed and per hectare of the onion varieties
Histograms with the same letter are not significantly different (Newman-Keuls test at 5%)

Table 1: Average values of the vegetative characteristics of onion varieties and the results of variance analysis

Varieties	pH (cm)	NL
Ares	57.90±05.69 ^a	12.17±01.62 ^a
Prema	63.13±07.05 ^a	12.20±01.94 ^a
Violet de Galmi	42.86±05.90 ^b	7.90±02.48 ^b
F	83.45	43.2
P	<0.001	<0.001

NB: Indexed values by the same letter in the same column are not significantly different (Newman-Keuls test at 5%), PH = Plant height, NL = Number of leaves and values in table are Means±Standard Deviation

DISCUSSION

Two months after transplanting the onions, Violet de Galmi lost more than half its plants, unlike the varieties Ares

and Prema, which maintained a significant number of plants until maturity. This loss of plants led to a low production of Violet de Galmi bulbs, unlike the varieties Ares and Prema. The latter two varieties are better adapted to the rainy season than

Violet de Galmi. However, the works carried out in Niger have produced results to the contrary. The results of their works showed a good adaptability of Violet de Galmi compared to Prema⁵. During their experiment, Prema recorded a high mortality rate. This difference in results can be explained by the climate in Côte d'Ivoire, which differs from that in Niger. Unlike Côte d'Ivoire, Niger has high temperatures and moderate rainfall. Côte d'Ivoire's climate is sub-humid and humid⁶.

In addition, the vegetative characteristics were more developed in Ares and Prema than in Violet de Galmi. This would have influenced the weight of the bulbs according to the varieties. In fact, the weight of the bulbs of the varieties Ares and Prema, which developed important vegetative characteristics, has been higher than that of Violet de Galmi, which had less developed vegetative characteristics. Excessive water would slow down the growth of the variety Violet de Galmi as well as the leaf production of the onion Violet de Galmi. To optimise the conditions for good development, it may be advisable to make raised beds to avoid flooding after heavy rain.

Bulb yield is closely linked to bulb weight and is influenced by the number of plants per area⁷. The varieties Ares and Prema with a high rate of live plants and the highest bulb weights consequently recorded the highest bulb yield values.

The works of Gedam *et al.*⁸ have shown that the tolerant onion accessions to waterlogging have a higher plant height and produce numerous and long leaves. In this study, the variety Ares, which had more developed vegetative characteristics than the other varieties, was more tolerant of excess water. Furthermore, according to the works of Ghodke *et al.*⁹, the onion's growth period of 20 to 90 days after transplanting is sensitive to the stress of waterlogging. The dodging method can therefore be used for extreme onion varieties sensitive to excess water. The aim is to establish plants that complete their crop cycle outside waterlogging periods, either by sowing earlier or later.

Onion production in the rainy season is advantageous, as the cost of irrigation is significantly reduced¹⁰. However, rainfalls can pose a problem for market garden production if they cause flooding. In this case, the water could lead to the proliferation of micro-organisms and cause diseases, but it could also asphyxiate the plant when it occupies the macrospores that are designed to maintain the soil surface. Nevertheless, an effective irrigation technique can improve the yield of any onion variety¹¹.

CONCLUSION

The specific aim of this study was to assess the agronomic and morphological potential of two onion varieties adapted to the rainy season. Violet de Galmi variety, a most popular variety in Côte d'Ivoire used as a control. The results showed a plant loss rate of 92.88% for Violet de Galmi and rates of 20.29 and 38.75%, respectively for Ares and Prema. The latter varieties had the best agromorphological performances. In view of these results, the varieties Ares and Prema can be recommended for rainy season cultivation in the north of Côte d'Ivoire. These varieties can also be grown in the wetlands of Côte d'Ivoire, with a view to extending onion cultivation in several agro-ecological zones.

SIGNIFICANCE STATEMENT

Onion cultivation is generally practiced in the dry season in Ivory Coast. This leads to a shortage of Ivorian onions on the market after the rainy season. This study aimed to propose onion varieties that could be cultivated in the rainy season. The work showed that Ares yielded an average of 24.17 ton of bulbs per hectare. Prema yielded 18.61 ton. Violet de Galmi recorded the lowest yield (2.06 ton). The ARES and PREMA onion varieties can be grown in the rainy season. The results of this study will allow farmers to practice onion cultivation also in the rainy season in order to improve national production in Côte d'Ivoire.

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