RELATIONSHIPBETWEEN THE ORIENTATION OF LEAVES IN SPACE AND THE RICE DEVELOPMENT PROCESS

Abstract

Summary

The objective of this study was to evaluate plants of SPU-79-96 forms with a short, dense, non-drooping panicle and SPU78-96 plants with a long, drooping panicle. This characteristic of these forms is the vertical arrangement of the leaves on the stem.

Methodology and results: Four growth components were measured after sowing in the field: the angle of deviation of the leaf from the main stem, leaf area, plant height, and length of the main panicle. The experimental design was a randomized split-plot with three (3) replicates. The lowest values were observed in plantsSPU-78-96(10,3 to $11,0^0$), highest in SPU-79-96 (10,7 to $12,7^0$), the leaf deviation angle in the control variety Nerica 4 was 23,7 to $25,5^0$. The ratio of panicle length to plant height was 23,3 to 29%. Plant yield was higher (1082,4 to $1384,5 g/m^2$) in the long panicle and was 59,13% higher than in the control variety.

Conclusion: It can be concluded that the vertical arrangement of the leaves plays a role in the production process, plants with a higher PAR efficiency accumulate more biomass, thus increasing yields.

Keywords: rice, space, process, variety, yield

INTRODUCTION

Rice has been cultivated in Southeast Asia since time immemorial; it is in this continent that the origin of Oryza sativa is located, where it is cultivated throughout the intertropical zone. Currently, rice is grown on all continents, and in almost all of Africa. In fact, rice can be grown anywhere it can find an average temperature, in the growing season, of more than 25^0 c; the minimum temperature of the irrigation water is equal to 14^0 c.The altitude at which paddy can be grown is 2000 m in the Philippines, 1600 m in Madagascar, 1300 m in the Andes and Zambia. There is no obvious effect of altitude per se on crops, but it does affect the plant through sunlight (Mayer et al., 1974).Rice loves prolonged sunlight. As a result, yields are generally higher in dry season crops (with irrigation) than in rainy season crops. The plant is generally influenced by photoperiodism, more or less depending on the variety; For many strains, the gradual decrease in the length of the day causes flowering, regardless of the vegetative development of the plant.This phenomenon allows rice farmers to sow their rice even a little late in the season, because they know that the harvest will always take place at the same time that corresponds to the end of the rainy season. Yields will decrease, but the plant will not suffer from drought at the end of the cycle.Plant growth and productivity (biomass accumulation) are mainly the result of photosynthetic activity, since the formation of organic matter is the result of the uptake of $CO_2$by green leaves under the influence of physiological radiation (Choulgine I.A., 1976).But for photosynthesis and productivity, it is necessary not only to absorb a lot of radiation, but it is important to use it with the utmost efficiency.The main element to increase the efficiency of the use of PAR is the spatial (architectonic) organization of the phytocenosis, which ensures the distribution of PAR in the thickness of the

Comment [D1]: Please check journal guidelines for reference citing cenosis.The general habit of the plants, the size of the leaf blades, the leaves, and their orientation relative to the vertical determine the behavior of phytocenosis as a medium of light scattering and energy for all leaf layers (Magi et al 1979).In solving this problem, an important role should be played by directing selection towards the creation of optimal morphophysiological types of plants (Mokronosov et al 1992).

MATERIALS AND METHODS

Site Selection: The experimental site of the present study was chosen in the department of Brazzaville, more precisely in district 2 Bacongo, within the premises of the Faculty of Science and Technology, more precisely in the experimental field. The work was carried out over a period of three years.The soil of the site provides for the water and nutrient needs of the plants. The potential for arable land as well as labour is there, and crop yields can be improved.However, work must be undertaken that will lead to the revitalization of the agricultural sector and that will lead to the development of modern livestock systems that provide meat products in abundance; This has not been the case to date for countries such as the Congo, which nevertheless have favourable assets in this field (Andrieu et al, 1981; Diamouangana 1989, 2000; Nkandza 1995,2000).The site is characterized by moderate rainfall of around 1387 mm of water per year. The lowest temperatures are observed in the dry season between July and August, with values between 23,7 and 24,2°c (Vennetier, 1977).

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Plant material: The plant material consisted of 3 rice cultivars (SPU-79-96, SPU-78-96, Nerica4), the 2 cultivars: SPU-79-96 and SPU-78-96 are of Asian origin and the cultivar Nerica 4 comes from West Africa. The focus of our study was plants of forms SPU-79-96 with a short, dense, non-drooping panicle and SPU-78-96 with a long, drooping panicle.A characteristic of these forms is the vertical arrangement of the leaves on the stem. As a control, we used the zoned variety NERICA 4, which has the usual leaf arrangement.

Setting up the test and experimental set-up: The trial was carried out in a 30 m long and 30 m wide landscaped experimental plot. This parcel has been subdivided into three blocks. One block has an area of 300 m^2 and contains 12 completely randomized plots of 20 m^2. The plots in a block were separated by 1.5 m driveways.On these blocks, sowing took place in November 2021 (rainy period) on plots respecting the densities. The experimental plots were ploughed by hand at a depth of 25 cm. After ploughing, sowing was done in rows on each plot at a rate of two seeds per plot. Before sowing, the seeds were kept in a bag and regularly exposed to the sun to avoid insect attacks.Two weeks after sowing, the plant is removed so that only one plant is left per plant. The germination power of the seeds was evaluated at the Plant Biotechnology and Production Laboratory of the Faculty of Science and Technology of MarienNgouabi University.After sowing, maintenance operations (weeding, hoeing) were carried out each time to avoid competition with weeds and insect housing.The experimental design was a randomized split-plot with 3 replicates. In one plot, the distance between plants was 0.20 m on the row and 0.25 m between rows, i.e. a density of 200000 plants/ha or 20 plants/m^2. Regular watering was carried out with tap water using a watering can.For a given treatment, observations and measurements were made on 10 rice plants randomly selected and taking into account their vigour. Weekly observations began from the fourth day after sowing to assess the rate of rice seed emergence. Rice growth and production data measurements were made at one month, two months and three months after planting.

Measured Variables and Data Analysis

The growth and production data were those obtained during the rice development cycle during our experiment (three month post-planting). Four growth components were measured after sowing in the field: the angle of deviation of the leaf from the main stem, the leaf area, the height of the plant, and the length of the main panicle.The other variables, the number of leaves per plant, were enumerated and the leaf biomass was obtained by delineating an area of one square metre ($1m^2$) per plot. The length of the main stem, the height of the plant were measured using a caliper and a steel decameter. All data were statistically analysed using XLSTAT software version 7.5.3.The orientation of the leaves in space and the process of rice development was carried out by comparing the average plant rates. The comparison between the means of all variables was made by the test of Student, Newmann and Keuls at the 5% level.

RESULTS

As a result of our study, it was found that plants with vertically arranged leaves are characterized by a slight angle of deviation of the leaf from the stem and a larger leaf area (Table 1)

Table 1 shows the data of the angle of deflection of the leaf in vertical forms did not exceed 15°. The lowest values were observed in SPU-78-96 plants (10,3 to 11,0°), the highest in SPU-79-96 plants (10,7 to 12,7°). The leaf deviation angle in the control variety Nerica 4 was 23,7 to 25,5°.Our studies showed that SPU-78-96 plants had the largest leaf area, which had leaves that were 2 times wider and 1,2 times longer. SPU 79-96 plants were 1,5 times lower than the control for this indicator, as they had broad but short leaves.It is assumed that due to the vertical arrangement of the leaves, the plant forms have a tolerance to thickening, without significantly reducing their productivity. This makes them valuable from a production perspective when grown with increased stocking density.

Table 2 shows that one of the main distinguishing features of vertical leaf forms is panicle length and its relationship to plant height. The share of the panicle in the total stem length is significantly higher than in currently zoned varieties.In contrast to SPU-78-96 plants, plants of SPU 79-96 had the shortest tassel among the varieties studied (15,0 to 17,2 cm). The ratio of panicle length to plant height ranged from 23,3% to 29,0%.

Table 3 shows plant yield, which was higher (1082,4 to 1384,5g/m2) in plants with long tassels. It was 59,13% higher than that of the control variety. Short panicle plants yielded only 15-42% (703,0-862,4 g/m^2).

Discussion

The same results are similar to that of Nefedova, thanks to this (vertical) orientation of the leaves, light penetrates the crop better and illuminates the leaves of the different stages more evenly (Nefodova, 1984).The creation of plants of a new morphotype was the rice plants obtained in 2002 with a vertical (erectoid) arrangement of the leaves on the stem (Begun et al 2002). However, to date, no studies have been conducted.Therefore, we felt it was important to determine the possibilities of using characters such as size (length and width), leaf position and photosynthetic surface area in breeding for rice productivity and economically valuable properties.

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CONCLUSION

In general, it can be concluded that the vertical arrangement of the leaves plays a role in the production process: plants with higher PAR efficiency accumulate more biomass, thus increasing yields. A detailed study of the genetic factors of the diversity of the organization and activity of the photosynthetic apparatus can provide a rich material for the creation of rice varieties with a highly active photosynthetic apparatus and, therefore, more productive than modern varieties.

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Table 1 - **Development of the leaf apparatus of rice forms available to erectoid leaves (2021-2023)**

Variant	Angle of deflection of the leaf from the stem, owls		Leaf area, cm²	
	SPU-79-96	SPU-78-96	SPU-79-96	SPU-78-96
Control	23,7	25,5	168,4	172,7
I	12,3	10,3	114,6	388,1
II	11,7	11,0	123,0	381,4
III	10,7	10,8	115,8	364,3
IV	12,7	10,4	112,7	344,3
V	12,7	10,9	125,8	346,9

Table 2 **- Characteristics of rice forms of a new morphotype in relation to panicle length and plant height (2021-2023)**

Variant	Height of asthenia, cm	Panicle length, cm	Ratio of panicle length to asthenia height %
SPU-79-96			
Control	81,4	15,0	18,4
I	64,0	17,2	26,8
II	57,2	16,6	29,0
III	62,4	15,0	24,0
IV	61,6	16,0	26,0
V	66,9	15,6	23,3
SPU-78-96			
Control	76,7	15,2	19,8
I	89,4	40,2	45,0
II	92,3	46,2	50,0
III	90,5	39,9	44,0
IV	89,9	38,2	42,5
V	91,6	39,2	42,8

Table 3 - **Yield of erectoid rice plants compared to control, g/m2 (2021-2023)**

Variant	SPU-79-96		SPU -78-96	
	Yield	Deviation from control	Yield	Fractional Deviation
Control	609,0	-	680,6	-
I	749,7	+140,7	1335,0	+654,4
II	856,8	+247,8	1082,4	+401,8
III	862,4	+253,4	1298,0	+617,4
IV	718,2	+109,2	1384,5	+703,9
V	703,0	+94,0	128,8	+448,2
HCP_{05}	29,4	-	67,6	-