Adaptability of some new high yielding corn varieties in Buton District

Agussalim, Yuliani, Z., Muh. Asaad and Amin Nur
Southeast Sulawesi Agricultural Technology Assessment Office
and Research Institute for Corn and Other Cereals
Email: Agussalim@pertnian.go.id

Abstract. The success of cultivation of a crop commodity is influenced by many factors, one of which is the choice of plant varieties to be developed. The selection of superior varieties of a plant that is developed will greatly determine the success of a crop cultivation business. One way to increase corn productivity is to plant high-yielding and adaptive corn VUBs with the local environment. The presence of an adaptive VUB, both free and hybrid, can significantly contribute to increasing productivity or national corn production. To find out the adaptive corn VUB in Buton District, it is necessary to do an Adaptation Study of Corn VUBs on dry land in Buton Regency. This study used a randomized block design (RBD), with 4 corn VUBs, namely Nasa 29, Bima 20 URI, Sukmaraga and Lamuru which were repeated 6 times. The results showed that the adaptability of corn VUBs planted in Buton District was quite good. Overall, the four VUBs are able to adapt to local conditions, this can be seen from the yield production better when compared to local varieties that have been commonly grown by local farmers. The average productivity of each corn VUB planted was Nasa 29 (6.90 t / ha), Sukmaraga (6.50 t / ha), Lamuru (6.02 t / ha) and the lowest was the Milky 20 URIs (5.87 t / ha).

1. Introduction

The success of cultivation of a crop commodity is influenced by many factors, one of which is the choice of plant varieties to be developed. The selection of superior varieties of a plant that is developed will greatly determine the success of a crop cultivation business [1]. The use of improved varieties is an attempt to increase crop production, so it is expected to be able to maintain a balance between the availability and demand of a commodity on the market. However, what needs to be considered in the use of a variety is the ability of its adaptability to the conditions of the climate and soil agro-ecosystem where the variety is cultivated. Its adaptability will be a determinant of whether the variety is suitable for development or not.

Corn is one of the commodities that has a broad market potential, due to the potential utilization of corn which is quite diverse starting as food, feed and industry [2]. As food, corn has an important and strategic role in maintaining food security. Corn plant has a high strategic and economic value, because of its position as the main source of carbohydrates and protein after rice [3]. Domestic corn demand, especially for animal feed raw materials, shows an increasing trend every year, this is in line with the growing development of the livestock industry in Indonesia. To anticipate this situation, efforts should be made to increase domestic corn production, so as to reduce dependence on imported corn.

Corn development in Southeast Sulawesi is spread in South Konawe, Bombana, Buton, Muna and North Buton Regencies (2015 Southeast Sulawesi Agriculture Office). The development area is 68.14 ha, with a productivity of 2.8 t / ha [4], still below the potential productivity of corn which reaches 8.4
to 11.7 t/ha [5]. The low yield obtained is thought to be caused by not using the VUB Corn which is adaptive/suitable at the development center.

Some research results indicate the use of Sukmaraga VUB, able to increase productivity between 4.5-5.6 tons of dry shelled/ha [6]. The results of the field study in the West Lombok Sheet, found that of the 6 varieties tested, Bima-4 and Bima-3 varieties gave high yields, which were on average 10.78 and 9.82 t/ha during the August harvest, 6.71 and 7.05 t/ha during the September harvest [7]. The results of the study in Central Maluku showed that the Bima-4 hybrid variety produced the highest dry shelled seeds which was 10.31 t/ha, then followed by the Bima-2 hybrid variety and the Sukariaga, Srikandi Kuning and Gumarang free-range varieties respectively 8.70 t/ha, 7.97 t/ha, 7.60 t/ha, and 7.26 t/ha [8]. Based on the above research results, one of the efforts to increase corn productivity is the use of high-yielding and adaptive VUB to the local environment. Until now, the free-roaming corn VUB such as Sukmaraga, Bisma, Lamuru, Gumarang, and Lagaligo or hybrids such as (Bisi-2, C7, Sema10, Bima-1, NK33, Jaya 1, Bima 20 URI and Nasa 29) have not its adaptability is known in Buton Regency, Southeast Sulawesi.

2. Materials and Methods

The study was conducted on dry land in Kumbewaha Village, Sentapina District, Buton Regency, Southeast Sulawesi, from May to August 2018. The study used a randomized block design with 6 replications. Four New Superior Varieties (VUB) of adapted corn are Bima Uri 20, Nasa 29, Sukma Raga and Lamuru. Soil processing is carried out using a plow (2 times) and followed by a rake/comb until the soil is not lumpy and level. When tillage is applied 1-2 t/ha of manure. Make a planting hole using torches, so that straight planting ropes are used to plant spacing that has been marked before every 20 cm. Making a planting hole as deep as ± 5 cm, each planting hole is filled with 1 seed and then covered with soil. Spacing between rows ± 75 cm and within rows ± 20 cm.

Fertilization is given at the following dosage: 1 ton organic fertilizer; Urea 200kg; NPK 200 kg (BPPT Sultra, 2018) or based on the test results of soil nutrient content in the study location. Fertilizing is done 2 times. Before being applied, fertilizer is mixed evenly and a dose is made for each plant so that the amount of fertilizer given is the same for each plant so that plant growth is evenly distributed. For fertilizer placement, a hole is made with the hole beside the plant with a distance of ± 5-7 cm from the plant. Fertilizer is inserted according to the specified amount, covered with soil.

The first weeding that is followed by the piling is done when the plant is 15-20 DAP. Weeding and piling can be done by using a hoe as well as for making irrigation channels for water distribution to plants. The second weeding is done in accordance with the conditions of weed growth in the field. Weeding can be done using herbicides or physically. Pest control is done if there are symptoms of a pest attack. Some of the pests that commonly attack corn plants are: corn stem borers, caterpillars, corn cobs borers, seed flies. While corn disease, namely: downy, leaf spot, leaf blight, rust, stem rot, stem rot. If there are symptoms of attack, especially stem borer, Carbafuran insecticide can be given by sprinkling to the tip of the plant as many as 3-4 items.

Observations include agronomic, economic data (farming inputs and outputs) and supporting data. Agronomic data consists of plant height, stem diameter, leaf length, leaf width, cob length, number of rows/cob, number of seeds/row, number of seeds/cob, dry shell weight. To determine the effect of several treatments on the observational parameters, a statistical analysis was carried out with the formulation [9] as follows:

$$Y_{ij} = \mu + K_j + \alpha_i + \varepsilon_{ij}$$

Ket. :
$\varepsilon_{i} = 1, 2, 3, ..., p$ (Number of treatments) and $j = 1, 2, 3, ..., l$ (Number of groups).
$Y_{ij} =$ observation value in the unit of experiment
$\mu =$ general midpoint
$K_j =$ effect of $j$-group treatment
$\alpha_i =$ effect of $i$-level treatment
$\varepsilon_{ij} =$ trial error in the $j$-th group experimental unit for the $i$-level treatment

If there are differences between treatments, then followed by Duncan's Multiple Range Test at the 5% test level with the following formulation:

$$Sy = \sqrt{KTG}$$

$\mu$ = general average

Ket.:

$Sy =$ comparative test value

$KTG =$ combined middle squared

$\mu =$ general average

If the treatment average is smaller ($<$) than the test value, then it is said that between the two treatments there is no significant effect (not significantly different), if the treatment average is greater ($>$) than the test value, then it is said that between the two treatments there is a real effect (significantly different). Further test results are then displayed with a superscript mark to the right of the average tested treatment (Duncan 0.05).

To find out the conversion of yield per plot to yield per hectare, the formula used by [10] is used:

$$\text{Result (t/ha)} = \frac{10,000}{100} \times \frac{KA}{LP} \times B$$

Where:

$KA =$ Moisture content during harvest

$LP =$ harvested area (m2)

$B =$ Weight (kg)

3. Results and Discussion

The topographical condition of the land in the Buton district generally has a mountainous, bumpy and hilly surface with an altitude between 100-500 M above sea level and the slope reaches 40°. Season conditions in the Buton district are the same as other regions, namely the rainy season which occurs between December - April and the dry season between July - September, while in May - June the wind direction and rainfall are erratic or better known as transmitters (Meteorological Station Kls III Betoambari City of Baubau).

The Buton Regency is composed of rock units which can be grouped into Mesozoic and Cenozoic rocks. Mesozoic rock groups are from Triassic to Upper Cretaceous and even to Paleocene, while Cenozoic groups are Tertiary and Quaternary. The rock group, which includes the Mesozoic, consists of the Winto Formation, the Ogena Formation, the Rumu Formation and the Tobelo Formation deposited from the Triassic to the Paleocene. Sedimentary rock groups including the Cenozoic then cover most of the Buton consisting of the Tondo Formation, the Sampolakosa Formation and the Wafulaka Formation deposited in the Early Miocene to the Late Pliocene A-Plistocene (BPS Buton 2017). The results of the Soil analysis using the PUTK (Dry Land Soil Test device) indicate the location of the activity has a slightly acidic pH content. Low C-organic, low P and Medium K.

Observations up to the age of 45 HST showed that the vegetative growth of 4 adapted varieties had various effects. There are those that have real effects and some that do not have real effects. The parameters that give effect are plant height, stem diameter, leaf length and leaf width, while those that do not give effect are the percentage of growth (Table 1). The growth of corn plants adapted until the 8th day after planting of 4 varieties which gave the highest percentage of growth in Nasa 29 (99.66%), followed by Bima 20 URI (99.33%) and Sukmaraga (99.00%). The highest is the Lamuru variety (96.66%). Seeds with high physiological quality (90%) are more tolerant of less optimal growth environment conditions than seeds with low physiological quality. Plants will be more effective using nutrients in the soil. Seeds with high vigor grow better than plants derived from seeds that lack vigor [11].
Table 1. Vegetative characters of several new improved varieties of corn, 2018

| Varieties   | Percentage varieties grow (%) | Plant Height (cm) | Stem diameter (cm) | Leaf length (cm) | Leaf width (cm) |
|-------------|-------------------------------|-------------------|-------------------|-----------------|-----------------|
| Nasa 29     | 99.66a                        | 119.30a           | 17.33b            | 59.82c          | 6.08b           |
| Bima 20 URI | 99.33a                        | 110.56ab          | 17.46b            | 67.26a          | 6.48b           |
| Sukmaraga   | 99.00a                        | 105.56b           | 19.70a            | 63.48ab         | 7.14a           |
| Lamuru      | 96.66a                        | 104.64b           | 17.30b            | 62.54ab         | 6.34b           |

Note: The same number in the same column is not significantly different from the Duncan Test at the 5% level

Plant height, stem diameter, leaf length and width significantly affected the 4 varieties adapted. High plant height growth was obtained in Nasa 29 variety, highest diameter in Sukmaraga variety, highest leaf length obtained in Bima 20 URI variety, and highest leaf width obtained in Sukmaraga variety. While the lowest observed parameters for height and stem diameter are Lamuru varieties, and the lowest observed parameters for length and width of leaves is Nasa 29. Plant height determines adaptation of maize varieties to the growing environment, but does not provide a positive correlation with [12].

The difference in plant height growth in each variety indicates a difference in growth vigor, the higher the plant the more efficient it is to utilize sunlight so that it can produce more photosynthates that are useful for vegetative and generative growth of maize plants [13]. The greater the photosynthetic synthesis produced by plants, the greater the results of photosynthetic that are transplanted to other parts of the plant, the results of photosynthesis are used by plants for plant growth and development processes which can ultimately increase production [14].

In this case, what plays a role in increasing crop yield is the photosynthetic results found in the leaves and stems that are transferred when filling seeds. If the results of photosynthetic that are stored in the leaves and stems are high, then the photosynthetic that is transferred when filling the seeds will be even higher. The results of photosynthetic contained in leaves and stems that are transferred when filling seeds play a role in increasing crop yields, so that if the results of photosynthetic stored in leaves and stems are high, the photosynthetic that is transplanted when filling seeds will be higher [14]. Table 2 shows that the sample dry weight (2 m x 3 m), the dry weight of 100 seeds and the productivity of the four varieties of corn adapted had a significant effect. While on the parameters of the length of the cob, the number of curing per cob and the number of seeds per cob did not have a significant effect.

Table 2. Generative characters of several new improved varieties of corn, 2018

| Varieties   | Cob length (cm) | row per cob (row) | Seeds per cob (seeds) | Weight of sample (kg) | Weight of 100 seeds (g) | Productivity (t/ha) |
|-------------|-----------------|-------------------|-----------------------|-----------------------|------------------------|---------------------|
| Nasa 29     | 18.43a          | 13.33a            | 479.33a               | 4.07a                 | 35.91a                 | 6.90a               |
| Bima 20 URI | 19.51a          | 13.33a            | 487.66a               | 3.54c                 | 34.52a                 | 5.87c               |
| Sukmaraga   | 18.43a          | 14.66a            | 495.66a               | 3.92ab                | 33.91a                 | 6.50ab              |
| Lamuru      | 18.33a          | 15.00a            | 511.33a               | 3.61bc                | 34.00a                 | 6.02bc              |

Note: The same number in the same column is not significantly different from the Duncan Test at the 5% level

Among the 4 varieties that were adapted the highest ear length was obtained in the Bima variety of 20 URIs, the highest number of curing culms and the highest number of seeds was obtained in the Lamuru variety. Whereas the lowest length of cob was obtained in the Lamuru variety, the lowest number of peruring cork was obtained in the Bima 20 URI and Nasa 29 varieties, and the lowest number of seeds was obtained in the Nasa 29 variety.

The sample dry weight, 100 seed dry weight and the highest productivity were obtained in Nasa 29 variety. While the lowest sample weight and productivity were obtained in Bima 20 URI variety, and
the lowest 100 seed weight were obtained in Sukmaraga variety. Variety is one of the many determining factors in plant growth and yield. Bisi 13 corn variety had the highest corn production compared to the pioneer 14 and 16 varieties grown in the lowlands [10].

Differences in the appearance of each VUB corn, especially differences in some observational variables are influenced by genetic and environmental factors. Genetic influence is a hereditary influence that is owned by each line while the environmental influence is the influence caused by habitat and environmental conditions. Environmental factors can cause the failure of pollination, pest attack and competition for nutrients, water, sunlight. Diverse genes from each variety have different characters [12]. In addition, the environment provides a role in the appearance of characters contained in these genes so that the appearance of a gene is still unstable which causes frequent similar plants but with different characters [13]. The genotype response to these environmental factors can be seen in the phenotypic appearance of the plants concerned so that different varieties will show different growth and yields as well.

The results of the correlation analysis between agronomic performance of plant height, and cob length showed a significant correlation to the dry shell weight of 0.481 each; and 0.408 (Table 3). This shows that the variable is very influential on the dry weight of corn. For this reason, the higher the corn plant will be followed by an increase in dry shell weight, because plant height is a characteristic of plants that affects the plant growth process. The process absorbs a lot of nutrients or nutrients, so that plant cells will grow or increase in height, ultimately resulting in higher dry shell yield [15]. Variable length of corn cobs are also influenced by genetic and environmental factors around the plant. These two factors are interrelated where the length of the cob is influenced by genetic factors, while the ability of plants to bring their genetic character is influenced by environmental factors.

|        | TT   | DB   | PD   | PT   | LD   | JBaT | JBB   | JBiT  | BB100 | BKP   |
|--------|------|------|------|------|------|------|-------|-------|-------|-------|
| TT     | 1    | -0.090 | 0.161 | -0.287 | 0.143 | -0.397 | 0.011 | -0.352 | 0.178 | 0.481* |
| DB     | 1    | 0.336 | 0.058 | 0.424* | 0.298 | -0.339 | 0.030 | -0.153 | -0.004 |       |
| PD     | 1    | 0.129 | 0.117 | -0.141 | 0.018 | -0.134 | -0.006 | -0.101 |       |       |
| PT     | 1    | -0.211 | -0.125 | 0.294 | 0.067 | 0.127 | -0.408* |       |       |       |
| LD     | 1    | 0.091 | 0.081 | 0.133 | -0.367 | 0.131 |       |       |       |       |
| JBaT   | 1    | -0.254 | 0.737** | -0.354 | 0.111 |       |       |       |       |       |
| JBB    | 1    | 0.462* | -0.320 | -0.188 |       |       |       |       |       |       |
| JBiT   | 1    | -0.536** | 0.014 |       |       |       |       |       |       |       |
| BB100  | 1    | 0.163 |       |       |       |       |       |       |       |       |
| Bpipilan | 1  |       |       |       |       |       |       |       |       |       |

Note: TT = plant height, DB = stem diameter, PD = leaf length, LD = leaf width, PT = cob length, JBaT = Number of rows per cob, JBB = Number of seeds per row, JBiT = number of seed per cob, BB = Seed weight 100, and PK = dry shell weight
* = significantly different
** = very different

4. Conclusion
Overall, the four new varieties are able to adapt to local conditions (mostly rocky), this can be seen from the better production compared to local varieties that are commonly grown by local farmers. Corn new released varieties which gives the highest productivity is Nasa 29 (6.90 t / ha), followed by Sukmaraga (6.50 t / ha), Lamuru (6.02 t / ha) and the lowest is Bima 20 URI (5.87 t /Ha).
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