Akta Agrosia

# Genetic Variability and Heritability Estimates of Growth and Yield Component of Curly Chili Pepper

**Rayuli Anira, Catur Herison*, Dotti Suryati**
Department of Crop Production, Faculty of Agriculture, University of Bengkulu
WR Supratman St, Kandang Limun, Bengkulu 38371, Indonesia

**ARTICLE INFO**

*Keywords:*
chili pepper
heritability estimate
genetic diversity

*Article history*:
Received: December 26, 2017
Accepted: December 29, 2017

*Corresponding author:
E-mail: catur_herison@unib.ac.id

**ABSTRACT**

Success of a breeding program is primarily determined by the genetic diversity of the genetic material used and heritability estimates of the character to be improved. The objective of this study was to determine genetic diversity and heritability of growth and yield components of 10 curly chili genotypes. This research was conducted in September 2015 - February 2016 in the Medan Baru field experiment of Faculty of Agriculture at Kandang Limun Village, Muara Bangkahulu Subdistrict, Bengkulu City. The experiment was arranged in a Completely Randomized Design (CRD) with ten genotypes and six replications. The genotypes used were Local Payakumbuh, Ferosa, Laris, Kopay, Romario, Keriting Hitam, Local Curup, Bogota, Sempurna and Mario. The results showed that genetic diversity of the ten varieties was narrow based on plant height variables, dichotomous height, stem diameter, flowering age, harvest age, fruit length, fruit diameter, weight per fruit and number of fruits. Stem diameter, fruit length, fruit diameter and weight per fruit had moderate heritability estimates; meanwhile, anthesis and number of fruits showed low heritability estimate.

## INTRODUCTION

Chili pepper is one of the important and commercially cultivated vegetable commodities because it can be grown in lowland to highland and has high economic value (Rubatzky and Yamaguchi, 1999). Chili cultivation is grouped into five species, namely *Capsicum annuum, C. frutescens, C. chinense, C. baccatum and C. pubescens* (Kusandriani, 1996). Among the five species are *Capsicum annuum* (big fruit and curly fruit type chili pepper) is the most widely cultivated in Indonesia (Kusandriani and Muharam, 2005).

The demand for chilies is projected to increase in line with the increase in population, and should be offset by increased production to keep prices affordable for consumers. Based on data from BPS (2015), there was an increase in national chili production by 6.09% and productivity by 2.3% in the last two years. Nevertheless, the increase in production is not sufficient to meet the domestic demand indicated by the high volume of imported chili (Subdirectorate of Import Statistics, 2016). One of the efforts to increase national production is through the development of high yielding varieties with high quality with the preferred quality of consumers.

The most important component that determines the success of plant breeding programs is genetic diversity. Extensive genetic diversity will facilitate the selection of superior genotypes that match the desired character (Kartiningrum and Efendie, 2005). Genetic diversity and heritability are beneficial in the selection process. Selection would be effective if it was carried out in populations with broad genetic diversity and high heritability. Heritability or inheritance is the size of the role of genetic factors to the phenotype (Mangoendidjojo, 2003). If the value of heritability in the broad sense is high, then the part of genetic factors in phenotypic appearance is enormous, or the influence of environment is minor (Sudarmaji *et al*., 2007; Syukur *et al.*, 2011). Oppositely, if the heritability estimate value is low, then the environmental influence is more significant than the genetic factor resulting in less effective selection (Sa'diyah *et al*., 2013).

The objective of this study was to determine genetic diversity and heritability of growth and yield components in 10 genotypes of curly chili pepper.

ISSN: 1410-3354

***Cited this as***: Anira, R., C. Herison and D. Suryati. 2017. Genetic variability and heritability estimates of growth and yield component of curly chili pepper. Akta Agrosia 20(2):48-53.

## MATERIALS AND METHOD

This research was conducted in September 2015 - February 2016 in Medan Baru Field Experiment of Faculty of Agriculture at Kandang Limun Village, Muara Bangkahulu Subdistrict, Bengkulu City. The design used was Completely Randomized Design (RAL) with ten genotypes and six replications. Genotypes used include Local Payakumbuh, Ferosa, Laris, Kopay, Romario, Curly Black, Local Curup, Bogota, Perfect and Mario.

The seeds were soaked in warm water for five minutes and then germinated in a wet paper tissue for four days until the radicles emerged. After that, the seedlings were transferred into a 72 cell tray containing mix media of soil, vermicompost, and manure with a 1: 1: 1 ratio. After the seeds were planted then were watered and pest controlled as needed.

Seedlings of 35 days old were transplanted into polybags of 30 cm in diameter and 40 cm height containing 9 kg topsoil mixed with 1 kg of manure. The polybags were spaced 50 cm x 50 cm apart. Fertilization was done by using Urea fertilizer 200 kg/ha (1 g/plant) when the seedlings were transplanted onto the polybags and four weeks after transplanting, SP-36 300 kg/ha (1.5 g/plant) and KCl fertilizer 100 kg/ha (0.5 g/plant) at transplanting.

The plants were watered everyday in the morning or afternoon if there was no rain. Within a week after transplanting, the dead or poor growth seedlings were replaced with healty ones. Four weeks after transplanting, the plants were supported by bamboo stake of 75 m length to prevent logging. Weed control was done manually by removing weeds surounding the plant. Pest and disease control was carried out preventively using pesticides with active element of profenofos 500 g/l, imidacloprid 25%, pyridaben 135 g/l, and mankozeb 80%. Spraying was done in the morning or afternoon with a time interval of 5 days. The fruits were harvested after at least 75% of the fruit turn red color. Harvesting was done for all of the fruits formed from the first flowering period.

The variables observed in this study include plant height, dichotomous height, stem diameter, flowering age, harvest age, fruit length, fruit diameter, weight per fruit, fruit weight, and number of fruits per plant. The data obtained were analyzed by variant (ANAVA) at 5% level. If the effect of genotype was significantly different, then proceed with Duncan's Multiple Range Test (DMRT) (Steel and Torrie, 1981). The estimation of the genetic variability component was performed based on the middle quadratic expectation value of genotype (Table 1)

According to Singh and Chaudhary (1979), the analysis of these variants can be estimated genetic variants, environmental variants and phenotypic variants, and genetic variation coefficient (KKG) as follows:

environmental variance $(\sigma^2_e) = KTe$

genetic variance $(\sigma^2_g) = \frac{KTg - KTe}{r}$

phenotypic variance $(\sigma^2_P) = \sigma^2_g + \sigma^2_e$

Based on the estimated value of genetic variant and phenotypic variant, it can be estimated the value of genetic diversity coefficient to describe the genetic diversity of the tested collection as well as the heritability meaning ($h^2_{bs}$) as follows:

$$\frac{\sqrt{\sigma_g^2}}{\bar{x}} X\ 100\ \%$$

$$h^2bs = \frac{\sigma_g^2}{\sigma_p^2}$$

Genetic coefisien of variation and broad sense heritability estimate was low ($h^2_{bs} < 20\%$), moderate ($20\% \leq h^2_{bs} < 50\%$) and high ($h^2_{bs} \geq 50\%$) (Stansfield. 1991).

## RESULT AND DISCUSSION

This research was conducted on September 2015-February 2016. Rainfall during planting suitable for chili is 80 mm with four times rain in a month. Rainfall ideal for the growth of red chili pepper plants is about 600-1200 mm/year or 50-100 mm/month (Sumarni and Muharram, 2005). The average temperature in this study is quite high that is 27 0C. The ideal average daytime temperature for chili pepper growth is 20 ° C-25 ° C (Rubatzky and Yamaguchi, 1999).

Watering the plants is done in the morning or late afternoon by using drilling well water near the research field. The low rainfall in September and the absence of rain in October caused the quality of well water used to be less useful because it has a high salinity level indicated by the value of electric conductivity (EC) of about 17.36 ms. The salt content contained in water decreases and electrical conductivity (DHL) is measured to 16.48 ms when tested on the first day after the November rain, while EC of freshwater is 0.03 ms. The high levels of salt contained in the deep well water is due to the seawater intrusion into the pores of the rocks polluting the groundwater contained therein. The intrusion of seawater can be caused by excessive groundwater uptake so that the pore of rock initially filled by fresh water can be replaced by the entry of seawater causing groundwater to turn into brackish water or even saltwater (Putranto and Kusuma, 2009).

At two weeks old, there were some plants

Table 1. Analysis variance of completely randomized design

| Source of variation | Degree of freedom | Mean square | Expected mean square |
|---|---|---|---|
| Genotype | g – 1 | $MS_g$ | $\sigma^2_e + r\,\sigma^2_g$ |
| Error | (r-1)(g – 1) | $MS_e$ | $\sigma^2_e$ |
| Total | rg-1 | | |

attacked by yellow and wilted diseases and needed to replant with the healthy seedlings. The pests found to attack the pepper plants were grasshoppers and aphids even in minimal amount. Pest and diseases control preventively conducted were able to minimize pest and pathogen attacks. Weed control is done manually by removing weeds that are in the polybags and cleaning weeds using a sickle in the area around the polybags.

At the time of entering the generative growth phase, there was high rainfall occurs with an intensity of 538 mm/month increasing fruit rot incidence. High rainfall is less suitable for the growth of red chili pepper plants; this is because the plants will be susceptible to fungal disease which can cause flower fall and fruit rot (Sumarni and Muharram, 2005).

Based on the results of the diversity analysis, there were significant differences between 10 genotypes of red curly chili pepper for stem diameter, flowering age, fruit length, fruit diameter, weight per fruit and number of fruit. On the contrary, in term of dichotomous height variables, harvest age and fruit weight per plant they were not significantly different (Table 2).

The coefficient of variation (CV) varies between 9.91% -19.50%, with the lowest CV value was on the length of fruit, and the highest value was on fruit weight per plant. The CV value indicates the level of accuracy of an experiment which was measured by the percentage of the standard deviation against the grand mean (Steel and Torrie, 1981). The higher the CV value, the lower the reliability of the study (Gomez and Gomez, 1995).

Ten genotypes of red curly chili pepper in this study showed differences in stem diameter and flowering age. Local Curup has the largest stem diameter that is significantly different in all genotypes except for Local Payakumbuh. Kopay has the fastest to flower that was not significantly different in all genotypes except Bogota and Sempurna. The variation in plant height, dichotomous height, and age to harvest was not statistically significant (Table 3). This was in contrast to Lasmiana's (2016) study, which states that plant height and dichotomous height are significantly different in the 20 observed genotypes. The highest plant height in Lasmiana (2016) was Kopay 56.27 cm. While in present study, Kopay's plant height was 59.30 cm and not significantly different to all other genotypes.

Different genotypes in the study had significant effects on fruit length, fruit diameter, weight per fruit and number of fruit. Kopay has the highest fruit length but statistically did not differ significantly to local Payakumbuh, Laris, and Bogota. Keriting Hitam had higher fruit diameter among than other genotypes except for Romario. The highest weight per fruits was Kopay which was significantly different from Lokal Curup, Bogota, Sempurna, and Mario. Lokal Curup has the highest number of fruits, but it was not significantly different to all other genotypes except Kopay which has the lowest fruit number (Table 4).

Fruit yield in this study was not significantly different among genotypes. The results of this study were different from that of Ganefianti et *al*. (2009), in the first year of fruit yield of genotype Laris was 47,32 gram and Mario 60,60 gram, whereas in the second year Laris 176,33 gram and Mario 249,66 gram. The difference between the results of Laris and Romario in this study and Ganefianti et al. (2009), suggesting that the same genotype and planted at different times will show different results.

The analysis results show that the genetic variability coefficient values ranged from 5.43 to 9.83 for all observed variables. These values were in the range of low genetic variability (Table 5). The variables with relatively low and relatively low CGVs were classified as narrow genetic diversity, and the variables with relatively high CGV criteria were classified as wide genetic diversity (Herawati et al., 2009). According to Gratitude et al. (2011) if a character denotes a narrow genetic diversity then the selection of these characters in this population is ineffective.

Heritability estimates is an indicator whether a character is influenced by many genetic or environmental factors. The estimation of heritability values may provide the genetic information needed in the subsequent selection process to determine which variables will be used as the determinant of selection (Ariani, 2009).

Stem diameter, fruit length, fruit diameter and weight per fruit showed moderate heritability value,

Table 2. Calculated F and CV values on the analysis of variance on all observed variables

| Variables | F value | CV(%) |
|---|---|---|
| Plant height | 1.86 $^{ns}$ | 12.27 |
| Dichotomous height | 1.66 $^{ns}$ | 14.02 |
| Stem diameter | 5.45 $^{**}$ | 10.80 |
| Days to flower | 2.09 $^{*}$ | 12.72 |
| Days to harvest | 1.27 $^{ns}$ | 9.91 |
| Fruit length$^{\#}$ | 3.21 $^{**}$ | 9.98 |
| Fruit diameter | 3.26 $^{**}$ | 16.02 |
| Weight per fruit$^{\#}$ | 2.70 $^{*}$ | 11.54 |
| Number of fruit$^{\#}$ | 2.38 $^{*}$ | 18.54 |
| Yield per plant$^{\#}$ | 1.36 $^{ns}$ | 19.50 |

Note : *,**, and $^{ns}$ = significantly different at α= 5%, 1% and not significantly different, respectively.
# = analysis was performed on transformed data of sqrt(y+1)

Table 3. Vegetative and generative growth of ten curly chili pepper genotypes

| Genotype | Plant height (cm) | Dichotomous height (cm) | Stem diameter (mm) | Days to flower (day) | Days to harvest (day) |
|---|---|---|---|---|---|
| Lokal Payakumbuh | 65.76 | 26.85 | 8.23 ab | 31.16 abc | 97.30 |
| Ferosa | 56.91 | 25.48 | 7.19 cd | 34.66 abc | 91.80 |
| Laris | 56.50 | 27.78 | 6.45 cd | 30.66 bc | 95.50 |
| Kopay | 59.30 | 30.75 | 6.17 d | 29.50 c | 89.30 |
| Romario | 55.33 | 25.40 | 7.38 bc | 33.16 abc | 89.20 |
| Keriting Hitam | 62.00 | 28.11 | 6.98 cd | 33.16 abc | 96.80 |
| Lokal Curup | 66.63 | 23.76 | 8.70 a | 29.83 c | 91.30 |
| Bogota | 57.16 | 28.08 | 7.47 bc | 36.33 a | 85.00 |
| Sempurna | 56.16 | 29.10 | 7.03 cd | 36.16 ab | 97.50 |
| Mario | 57.75 | 26.98 | 7.17 cd | 32.66 abc | 95.30 |

Note: The number followed by the same letter in the same column is not significantly different based on Duncan's Multiple Range Test with α= 5%.

Table 4. Fruit characteristics and yield component of ten curly chili pepper genotypes

| Genotype | Fruit lenght (cm)# | Fruit diameter (mm) | Weight per fruit (g)# | Number of fruit# | Yield per plant (g)# |
|---|---|---|---|---|---|
| Lokal Payakumbuh | 12.65 ab | 5.20 bc | 3.37 ab | 28.00 ab | 81.13 |
| Ferosa | 9.70 bc | 5.40 bc | 2.58 abcd | 34.33 a | 81.36 |
| Laris | 10.85 abc | 5.69 b | 2.84 abcd | 29.16 ab | 64.30 |
| Kopay | 13.36 a | 5.42 bc | 3.44 a | 17.00 b | 48.85 |
| Romario | 8.23 c | 5.88 ab | 2.55 abcd | 33.66 a | 74.76 |
| Keriting Hitam | 9.28 c | 6.90 a | 3.14 abc | 21.33 ab | 57.90 |
| Lokal Curup | 9.66 c | 4.45 c | 1.93 d | 36.16 a | 63.16 |
| Bogota | 10.41 abc | 4.86 bc | 2.32 cd | 22.50 ab | 51.38 |
| Sempurna | 9.76 bc | 5.62 b | 2.40 bcd | 25.00 ab | 50.21 |
| Mario | 8.80 c | 5.77 b | 2.32 cd | 35.00 a | 73.95 |

Note: # analysis was performed on transformed data of sqrt(y+0.5)
Numbers followed by the same letter in the same column is not significantly different based on DMRT with α= 5%

and for flowering age and number of fruits were included in low category (Table 6). High heritability values are efficiently used as selection criteria because they are more determined by genes that are stable in all environmental conditions.

Selection is the basis of all plant improvements to obtain superior varieties. One important component of the selection program is genetic diversity. Extensive genetic diversity will facilitate the selection of superior genotypes that match the desired character (Kartiningrum and Efendi, 2005). However, in the present study variables of stem diameter, fruit diameter and the number of fruits, flowering age, fruit length and weight per fruit showed narrow genetic diversity value. The narrow genetic diversity indicates the magnitude of the environmental influence on the character (Hartati *et al*., 2012). According to Budianti (2007), the narrow genetic diversity shows that individuals in the population have a uniform character or almost the same so that the selection process is not effective.

According to Sutjahjo *et al*. (2015), the proportion of genetic influences on phenotypes can be suspected based on heritability values. Heritability is a measure of the degree of genetic influence on phenotype (Sitompul and Guritno, 1995). Heritability in the broad sense is a comparison between the total genetic variant and the phenotype variant (Mangoendidjojo, 2003). The variation of flowering age and number of fruits have a low heritability estimate value that is not effective to be used as a reference for selection although the amount of fruit has a wide genetic diversity. This is because the variables are more influenced by environmental factors than genetic factors so that if the plants were grown in the different environment results will be biased (Syukur *et al*., 2010). Wide genetic diversity does not necessarily guarantee the effectiveness of the selection program.

Variables of stem diameter, fruit length, fruit diameter, weight per fruit and fruit weight per plant had medium heritability value. According to Stommel and Griesbach (2008), the heritability estimates of a character with medium and high category indicate that the character is influenced by genetic factors instead of by environmental factors so that the character can be used as a reference in the selection of further chili plants.

The stem diameter and fruit diameter variables show moderate heritability estimate and have wide

Table 5. Coefficient of genetic variance (CGV) of generative growth, fruit characters and yield componen of ten curly chili pepper genotypes

| Variables | CGV (%) | Category | Criteria |
|---|---|---|---|
| Days to flower | 5,43 | low | narrow |
| Stem diameter | 9,33 | low | narrow |
| Fruit length | 6,13 | low | narrow |
| Fruit diameter | 9,83 | low | narrow |
| Weight per fruit | 6,09 | low | narrow |
| Number of fruit | 8,89 | low | narrow |

Table 6. Genetic variations, error range, phenotype variety and heritability estimate of generative growth, fruit characters and yield componen of ten curly chili pepper genotypes

| Variables | $\sigma^2_g$ | $\sigma^2_e$ | $\sigma^2_f$ | $h^2_{bs}$ | Criteria |
|---|---|---|---|---|---|
| Days to flower | 3,160 | 17,34 | 20,5 | 15,41 | low |
| Stem diameter | 0,461 | 0,61 | 1,07 | 43,07 | moderate |
| Fruit length | 0,040 | 0,10 | 0,14 | 28,57 | moderate |
| Fruit diameter | 0,295 | 0,78 | 1,07 | 27,44 | moderate |
| Weight per fruit | 0,011 | 0,04 | 0,05 | 22,58 | moderate |
| Number of fruit | 0,218 | 0,94 | 1,15 | 18,84 | low |

Note: $\sigma^2_g$ = genetic variance, $\sigma^2_e$ = environmental variance, $\sigma^2_f$ = phenotypic variance, $h^2_{bs}$ = heritability

genetic diversity values so that these two variables can be used as a material for further selection considerations. While the fruit and weight variables per fruit have medium heritability value with a narrow genetic diversity, then the variables can not be used as a determinant of selection. According to Hastuti *et al*. (2016) if the heritability prediction value is included in the low to moderate category and the percentage of genetic progress of expectation including low to high enough category then the variable is less effective if used as an improved indicator in the selection process.

## CONCLUSION

Ten genotypes used in this study were genetically uniform based on plant height, dichotomous height, stem diameter, flowering age, harvest age, fruit length, fruit diameter, weight per fruit and number of fruits. The trunk diameter, fruit length, fruit diameter and weight per fruit have a moderate heritability guess value. For variables of flowering age and number of fruits have low assumption of heritability value. It is necessary to add other genotypes to increase genetic diversity as a plant breeding material.

## REFERENCES

Ariani, D.A. 2009. The estimation of the genetic parameters and the evaluation of the yield power of six chilli halal genotypes diallel at low light intensity. UndegraduateThesis IPB. (In Indonesian)

BPS. 2015. Large chilli production. http://www.bps.go.id/brs/view/id/1168. Retrieved on 16 May 2016. (In Indonesian)

Budianti, T. 2007. Variability and heritability of some fruit characters from 15 accessions of papaya F1 generation. Agrin. 11 (2): 103-110. (In Indonesian)

Ganefianti, D.W., D. Suryati and Hasanudin. 2009. The stability analysis of 6 chilli genotypes using additive main effect multiplicative interaction (AMMI) method. Agrosia Deed. 12 (2): 147-154. (In Indonesian)

Gomez, K.A. and A.A. Gomez. 1995. Statistical Procedures for Agricultural Research. Translation from: Statistical Procedurs for Agriculture Research. Translator: E.Sjamsudin and J.S. Baharsjah. Publisher University of Indonesia. Jakarta. 698 p. (In Indonesian)

Hartati, S., A. Setiawan, B. Heliyanto, and Sudarsono. 2012. Genetic diversity, heritability and correlation among characters of 10 selected genotypes of Jatropha curcas L.). Journal of Littri. 18 (2): 74-80. (In Indonesian)

Hastuti, N.M.D., I. Yulianah and D. Saptadi. 2016. Heritability and genetic progression of the 7 families of F3 population of large chili pepper (*Capsicum annuum* L.) TW 2 X PBC 473. Jurnal Produksi Tanaman. 4 (1): 63 – 72 (In Indonesian)

Kartikaningrum S. and K. Effendie. 2005. Genetic diversity of Spathoglottis orchid germplasm. J. Hort. 15 (4): 260-269. (In Indonesian)

Kusandriani, Y and A. Muharam. 2005. Chili Seed Production. Indonesian Vegetable Research Institute. Bandung. (In Indonesian)

Kusandriani, Y. 1996. The establishment of Chili Hybrids. Monograph. Indonesian Vegetable

Research Institute. Bandung. (In Indonesian)

Lasmiana. 2016. Genetic Variety and Heritability Qualitative and Quantitative Variables 20 Chrysantum Genotype (*Capsicum annum*). Undergraduated Thesis UNIB

Mangoendidjojo, W. 2003. Fundamentals of Plant Breeding. Kanisius. Yogyakarta.

Putranto, T.T And K.I. Kusuma. 2009. Groundwater problems in urban areas. Technique 30 (1): 48-57. (In Indonesian)

Rubatzky, V.E and M. Yamaguchi. 1999. Vegetable World 3. Translated by C. Herison. ITB Publisher. Bandung. (In Indonesian)

Sa'diyah, M., M. Widiastuti, and Ardian. 2013. Behavior, diversity, and heritability of long bean agronomy character (*Vigna unguiculata*) F1 generation from crossing three genotypes. J Agrotek Tropika. 1 (1): 32-37. (In Indonesian)

Singh, R.K., and B.D. Chaudhary. 1979. Biometrical Methods in Quantitative Genetical Analysis. Kalyani Publications.

Sitompul, S.M, and B. Guritno. 1995. Analysis of Plant Affairs. Gadjah Mada University Press, Yogyakarta. (In Indonesian)

Stansfield, W.D. 1991. Schaum's outline of theory and problems of genetics. McGaw Hill Steel.R.G.D and J.H.Torrie. 1981. Principles and Procedures Of Statisticsa Biometrical Approach. International Student Edition. McGaw Hill Kogakusha.

Stommel, J.R., R.J. Griesbach. 2008. Inheritance of fruit, foliar and plant habit attributes in Capsicum. J. Amer. Soc. Hort. Sci. 133: 396-407.

Subdirectorate of Import Statistics. 2016. Foreign Trade Statistical Bulletin. Import, BPS-Statistics Indonesia, ISSN: 0126-3668,

Sudarmaji. R. Mardjono, and H. Sudarmo. 2007. Genetic variation, heritability, and genotypic correlation of important properties of sesame plants (Sesamum indicum L.). Journal of Littri 13 (3): 88-92. (In Indonesian)

Sumarni, N and A. Muharam. 2005. Cultivation of Red Chillies Plant Vegetables Research Crops. Bandung. (In Indonesian)

Sutjahjo, S.H ,. C. Herison., I.Sulastrini and S. Marwiyah. 2015. Estimate genetic diversity of several growth and yield characteristics in 30 local tomato genotypes. J. Hort. 25 (4): 304-310 (In Indonesian)

Syukur, M., S. Sujiprihati and A. Siregar. 2010. The estimation of the genetic parameters of some agronomic characters of chili f4 and the evaluation of the results using the design of Augmented Design. Journal of Agrotropic 15 (1): 9-16.

Syukur, M., S. Sujiprihati, R. Yunianti, and D.A. Kusumah. 2011. Estimation of genetic variability and heritability of component character results Some chili genotypes. J. Agrivigor 10 (2): 148-156