Asian Journal of Agriculture and Rural Development
Volume 7, Issue 1(2017): 17-27

http://aessweb.com/journal-detail.php?id=5005

Identification, selection and observation of Nuansa Sanggabuana soybean, its yield and resistancy to diseases

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ARTICLE HISTORY:

Received: 12-Mar-2017
Accepted: 10-Apr-2017
Online available: 25-Apr-2017

Keywords:
Description,
Glycine max,
Identification,
Resistance,
Selection,
Yield

ABSTRACT

Study to get Nuansa Sanggabuana (NS) of Karawang soybean variety to be released to become superior variety was conducted district of Karawang, West Java province, from 2010 to 2014. The study consisted of identification, purification and description, adaptation test. The identification step was conducted positive mass selection; purification was done a negative mass selection, adaptation yield test and also resistances to diseases. The test was arranged in randomized block design by comparing NS Karawang with Anjasmoro, Argomulyo, Orba, Grobogan, and Rajabasa which was repeated 4 times. Identification result had two NS Karawang local variants based on colour on the trunk, which were grey trunk fur and brown trunk fur. Variant which was purified for the next generation was one brown trunk fur. On-off type individual purification step was discarded and made description based on UPOV standard. Adaptation test result showed that differences between NS Karawang and Anjasmoro, Argomulyo, Orba, Grobogan, and Rajabasa variety on plant's height, number of productive trunk, number of pod for each plant, weight of 100 grains, yield per plant, yield per unit, and yield per hectare. NS Karawang had higher yield than Anjasmoro, Argomulyo, Orba, and Rajabasa but lower yield than Grobogan.

Contribution/ Originality
The article gives steps in plant development program, especially to develop landrace variety and turns it into a new superior variety, and also release the variety

DOI: 10.18488/journal.1005/2017.7.1/1005.1.17.27
ISSN (P): 2304-1455/ISSN (E):2224-4433

Citation: Ai Komariah, Noertjahyani Hardedi and Salman Buhturi (2017). Identification, selection and observation of Nuansa Sanggabuana soybean, its yield and resistancy to diseases. Asian Journal of Agriculture and Rural Development, 7(1), 17.27.

1. INTRODUCTION

In West Java, soybean is one of the superior commodity which become priority in agriculture development activities. Subandi (2012) said that Indonesia is vulnerable to a drop in rice production and has a little rice reserve. The government has paid little attention to agriculture hence agricultural production is not keeping pace with demand. Indonesia imports many kinds of agricultural products to meet domestic demands.

To minimize the import of agricultural products one of is the increase of soybean production that could be done by fixing the soybean production system, they are: (1) Development of planting areas through planting index increament (PI); (2) Increament of Productivy through adopting the technology which fixed variety and (3) Production monitoring (Heriyanto and Imam, 2006). Improving the agricultural production consists of genotypic and agronomical (watering, culturing, fertilizing etc.) as stated by Subandi (2012a) Applying fertilizer is a must in agronomic point of view, especially in soil with less fertile due to scarce nutrients or unbalanced nutrition.

Genotypic effort is the use of superior variety in specific location was one of the alternative to increase soybean production. In the effort to increase availabity of the superior seed was done many efforts in breeding which by release a new superior varie ty whether local or national as the result of plant breeding. There are about 80 soybean varieties which was released and distributed to farmer, but must firstly be assessed its adaptation level and stability on many agroecosystem such in irrigation rice field, rainfall and land so will be known which variety will has high result on that argosystem. New superior variety could be produced by many ways which were: introduction, crossbreed, radiation or through purification/bleaching from known local variety and accepted by farmers. A variety said to be suitable morphologically, physiologycal and agronomical superiors. A few of them are: Harvest age, yield, resistance to the main pests, resistance to environtment, resistance to pest, seed toleration to mechanical damage, quality of the yield and nutrient value also contain certain substance which helpful. These characteristics had been considered as superior.

Local NS Karawang variety was one of kinds of local soybean which had distributed to people long time ago especially in Karawang district. NS soybean was a local variety adopted by farmers because of big shape, tasteful and high yielding. Based on the origin, NS initial named after a mountain in Karawang district (*Nuansa Sanggabuana*) which used for local soybean variety that had grown since 1987. Further development done by farmers started in 1992 through student activity of a university, sub-district of Lemahabang. One of the farmer in which constinuously cultivated the variety of NS soybean. Production of NS local soybean variety in District Karawang every year kept increasing. Harvested area, production and productivity of NS Local soybean in district Karawang in the year of 2008 was 11 ha with 17 tons of production and 1.05 ton ha^{-1} productivity while in 2015, harvested area was 160 ha, 294 tons of production and it means 1.825 ton ha^{-1} production (Department of Agricultural, Fishery, and Forestry District of Karawang, 2015). In the year of 2014 Soybean production in district Karawang was 719 tons, in West Java was 11526 tons, and in Indonesian was 954997 tons (Central Bureau of Statistic, 2016). Asean soybean production in 2014 was 1484000 tons (Asean Statistical Year Book, 2016). Comparison of Soybean production between Karawang District, West Java and Indonesian in 2014 showed at Figure 1.

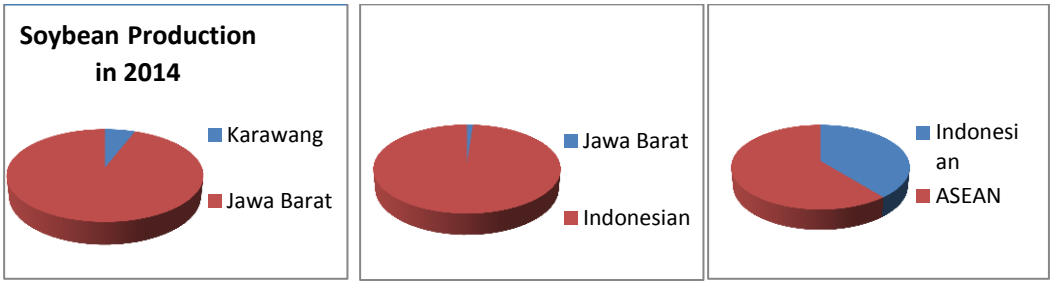

Figure 1: Comparison of Soybean production between Karawang District, West Java and Indonesian

The Agriculture office of Karawang in cooperation with the office of Supervision and Sertification of the Seed Food Plants and Holticulture institution from West Java and Breeders from Winaya Mukti University had carried out the identification and early purification selection of NS Soybean variety. The variety of soybean will be developed and had the best superiority also was adapted by by farmers.

The next step after identification and early selection was seed purification to prepare seed resource, make description and observation for yield test and resistance to plant disease. In every test steps was always done a selection process to ensure purity of the seed. General research had purpose to get NS Local variation then released to be superior variety.

2. MATERIALS AND METHOD

The activities in NS Karawang breeding program were steps they were;

2.1. Identification and selection of NS Karawang variety

Selection method which was applied in this step was positive mass selection which had been done since 2009 and 2010. Breeder and farmers carried out the phenotype performance observation for each individual in one population then chose individual that will be planted and purified on the next generation.

2.2. Seed purification and description

In 2011 selection result of the positive mass was chosen and NS Karawang Local soybean variance B (brown fur trunk) then planted back and then did a negative mass selection. On negative selection only selected plant individuals which wanted and cast plant that diverged from wanted criteria (Fehr, 1987). Negative mass selection had done to purify to the variety in order to produce NS Karawang Local soybean seed which had the genetic purity proven.

2.3. Adaption test

Adaptation test purpose was to detect superiority and variety interaction to environtment. Adaption test was done in wet rice field that was used to be placed to plant rice. Located in sub-district Pangkalan, District Karawang, West Java Province in the elevation 85 above sea level and the soil was Grumosol (Department Counseling of Agricultural, Fishery, and Forestry Sub District Pangkalan, 2010). Rainfall type C based on Schmidt and Ferguson (1951) classification, and was done from 2013 - 2014.

Material which used for yield test and resistance to diseases Soybean of NS Karawang Local variety, Anjasmoro, Argomulyo, Orba, Grobogan, and Rajabasa, Manure, Urea (N 46%), SP-36 (P_2O_5 36%), KCl (K_2O 60%), and legin.

Apparatus which used were grass knife, water pump, dibble, measuring tape, scales, bamboo stake, ruler, name board, bucket, *moisture tester*, handsprayer and stationery, scissors, and sack.

Research based on two set, this was for review the potential result of NS variety than other superior varieties, and know NS variety superior which was resistance to main pests. Research method which used was Randomized Block Design, consisting of 6 varieties which were NS Karawang, Anjasmoro, Argomulyo, Orba, Grobogan and Raja Basa which repeated 4 times, that there were 24 plots of trial.

Qualitative character observation was done while plant growth based on UPOV standard (National Committee for Genetic Resources, 2006). Yield Components of the observation were including number of productive branch, number of pod, number of seed, weight of 100 seeds, weight of seed per plant and yield per hectar did on sample plant which randomly determined. Measurement of intensity of the attack of the disease based on attack category such as on Table 1.

Table 1: Leaf rust attack category on soybean based on attack intensity

No	Pests / Disease Attack Intensity	Category
1.	Damage between 0 % - 10 %	Resist
2.	Damage between > 11 % - 25 %	Moderately Resistant
3.	Damage between > 26 % - 40 %	Moderately Resistant
4.	Damage between > 40 % - 60 %	Susceptible
5.	Damage between > 60 %	Very Susceptible

Note: On plant disease observation which used was leaf, root, and pod part

Disease intensity measured based on rank and level of pustule attack on leaf. Resistance level of soybean plant to rust disease based on IWGSR (Yang, 1977), as follows : Score < 222 = resist; Score = 222 = a bit resist ; Score > 222 = susceptible and Score > 333 = very susceptible.

Data analysis which used in this research was varians analysis/F test (Gomez and Gomez, 1995). If F test result between treatment shows variety, then to know the difference between treatments was done next test by range different test using continuation Smallest Significant Difference test on 5% level.

3. RESULT AND DISCUSSION

3.1. NS Karawang variety identification

Based on positive selection result to mixed population chosen two variants of Local NS Karawang which based on colour of the trunk fur, which were grey and brown. The variant which was chosen to be purified and developed for the next generation was the one with brown trichoma.

Table 2: Qualitative character of two varian NS karawang variety

No	Inspection Time	Character	Expresion	
			Varian A	Varian B
1	10-15 day after planted (dap)	hypocotile colour	Purple	Purple
2	When blooming	Flower colour	Purple	Purple
3	When blooming	Blooming agre (dap)	Fast flowering (<32 days)	Fast flowering (<32 days)
4	When blooming	Leaf shape	Lanceolate	Lanceolate
5	When blooming	Leaf colour	Green	Green
6	When blooming	Leaf surface	Soft	Soft

7	50-60 DAP	Grow type	Determinate	Determinate
8	50-60 DAP	colour of trachoma	Brown	Grey
9	When ripe	Ripe age (dap)	Early Harvest (<70 days)	Early Harvest (<70 days)
10	When ripe	Plant's height when ripe	Average (41-50 cm)	Average (41-50 cm)
11	When ripe	Ripe pod's colour	Brown	Brown
12	When ripe	Pod piece' resistance	Not easy to break	Not easy to break
13	When ripe	Seed skin's colour	Light yellow	Light yellow
14	When ripe	Hilum colour	Light brown	Light brown
17	50 and 70 DAP	resistance to rust disease	Moderate	Moderate
18		Adaptation area	Drought tolerance	Drought tolerance

3.2. Seed purification and description

Observation result and morphology data entry based on UPOV standard, could be used as matter in variety description compiling. The result of the qualitative performance observation of local NS soybean plant from District Karawang which dominant and purified as seen on Table 3.

Table 3: Qualitative character of NS karawang local variety

No	Inspection Time	Character	Explanation
1	10-15 (dap)	Hipocotile colour	Purple
2	When blooming	Flower colour	Purple
3	When blooming	Blooming agre (dap)	Fast flowering (<32 days)
4	When blooming	Leaf shape	Pointed Ovatus
5	When blooming	Leaf colour	Green
6	When blooming	Leaf surface	Soft
7	50-60 DAP	Grow type	Determinate
8	50-60 DAP	colour of trachoma	Brown
9	When ripe	Ripe age (dap)	Early harvest (<70 days)
10	When ripe	Plant's height when ripe	Average (41-50 cm)
11	When ripe	Ripe pod's colour	Brown
12	When ripe	Pod piece' resistance	Not easy to break
13	When ripe	Seed skin's colour	Light yellow
14	When ripe	Hilum colour	Light brown
17	50 and 70 DAP	resistance to rust disease	Average (moderate)
18		Adaptation area	Water is available on terrain

Based on Table 3 could be known that NS Karawang Local variety included to soybean with plant's height on average category, with the result that the potencial could be improved through more crowded density of the population, and early harvest aged, which less than 70 so could be very match to use for plant in legumes-rice plant pattern which planted by the end of raining season on wet rice field.

3.3. Yield test result

1). Plant's Height, Branch Number and Pod Number

Plant height characteristic could be use as one of the plant growth component to chose grooves with great yield. Because of that, the higher the plant expected more heathly knot formed so the pod number and seed will increase too.

Table 4: Plant's height, number of productive trunk, number of pod per plant range

Variety	Plant's Height (cm)	Number of Productive Trunk	Number of Pod for Per Plant
NS	46.95[b]	3.97[a]	31.00[a]
Anjasmoro	56.55[a]	4.15[a]	29.00[ab]
Argomulyo	40.05[d]	3.98[a]	25.25[c]
Orba	47.20[b]	3.72[a]	21.25[d]
Grobogan	47.57[b]	3.86[a]	32.25[a]
Rajabasa	43.65[c]	3.79[a]	27.25[bc]

Explanation: Mean which are followed by the same letter of the same coloumn are not significantly different based on significant different range test p> 5%

Based on Table 4, plant height among varieties which were tested were significant different. NS variety which tested had plant height range was 46.95 cm while the comparison plant height range was 43.65 cm to 56.55 cm. Differences character between varieties caused by genetic factor. F1 test by Heri *et al.* (2015) showed that G1 (♀Detam II X ♂Anjasmoro) and G2 (♀Anjasmoro X ♂Detam II), significantly different of flower age, plant height, number of seeds and pods with seed 1, number of seeds and pods with seed 2, number of seeds and pods with seed 3, number of pods containing, number of seed per plant, seed weight per plant and 100 seeds weight. G5 (♀Grobogan X ♂Detam II) and G6 (♀Detam II X ♂Grobogan) significantly different of flower age, harvesting time, primer branch number, number of seeds and pods with seed 2, number of seeds and pods with seed 3, number of pods containing, number of seed per plant and seed weight per plant. Difference between F1 and F1 reciprocal occur because of maternal inheritance individuals crossing result.

Number of productive branch among varieties which tested showed unsignificant different. Based on pod number, NS variety had significant difference of pod number and more than Argomulyo, Rajabasa and Orba varieties, mean while with Anjasmoro and Grobogan varieties didn't show significant difference. Differences character between varieties caused by genetic factor. Research by Hero *et al.* (2015) showed that the strongest relationship of seeds yield was seen with number of branches per plant (b=1.65) followed and the weakest with plant biomass (b=0.02). Therefore this trait should be considered to be most important while selecting improved soybean genotypes under semi-arid conditions. The yield obtained by early planting was positively correlated with the pods m^{-2}, seeds pod^{-1}, and oil contents, but negatively correlated with the sterile pod rate, 100 seed weight and protein content. In the early planting, the U.S. cultivars had greater pods m^{-2}, seeds pod^{-1} and oil content and less sterile pod rate, 100-seed weight, and protein content than the Japanese cultivars. These results suggest that early planting can increase the yield in southwestern Japan, if cultivars with agronomic traits observed in the U.S. cultivars of this study are grown (Naoki *et al.*, 2016).

Result of analysis statistically, dried soybean yield per unit and of dried soybean yield per hectare could be seen on Table 5.

Table 5: Weight of 100 grain, yield per plant, yield per unit, yield per hectare

Variety	Weight of 100 Grain (gram)	Yield per Plant (gram)	Yield per unit (kg/80 m2)	Yield per Hectare (ton/Ha)
NS	18.36[a]	16.75[b]	21.45[b]	2.68[b]
Anjasmoro	14.87[bc]	12.70[c]	16.52[c]	2.07[c]
Argomulyo	15.39[b]	11.69[d]	15.25[d]	1.91[d]
Orba	13.33[c]	8.81[e]	11.18[e]	1.40[e]
Grobogan	19.22[a]	18.03[a]	23.40[a]	2.93[a]
Rajabasa	14.92[bc]	12.24[cd]	15.28[d]	1.91[d]

Explanation: Mean which are followed by the same letter in the same coloumn are not significant difference based on Significant different range test p> 5%

Based on Table 5 could be known that component of production character performance of NS Karawang variety, generally, almost equal the performance from National Superior Variety which already distributed to people, even weight of 100 grains of NS Karawang variety was the same as Grobogan variety and more superior from Anjasmoro, Argomulyo, Orba and Rajabasa varieties. Bekele and Getnet (2011), said that seed yield was strongly associated with seeds plant $^{-1}$, pods plant $^{-1}$, seeds pods^{-1}, days to maturity and grain filling period. Adie and Krisnawati (2007) said that soybean seed grouped based on big (weight >14 g/100 seeds), average (10-14 g/100 seeds), and small (<10 g/100 seeds). Based on that group, NS Karawang which tested included in big seed seed character (18,36 grams) it means more production of seed..

Observation to NS Karawang local variety had potential yield generally close to Grobogan variety even above Anjasmoro, Argomulyo, Orba and Rajabasa varieties. Yield potential was interaction with environment factor. Research by Popovic *et al.* (2015), showed that Yield in soybean grain was positively correlated with oil yield and precipitation (r= 0.94**, r= 0.92**), and negatively correlated with oil content (r= 0.37) and with temperature (r= 0.93**). The other research by Dankit and Wafula (2002) showed that Cultivar yield stability at the environments, yielding ability, height at maturity as well as days to maturity formed the basis for assessing cultivar suitability for a given environment. There were significant cultivar x environment interactions for all the response variables tested. Four cultivars, EAI3600, Gazelle, Nyala and Sable were identified to be stable in the different environments and were consistently observed to be high yielding and of appropriate height, maturity period and highly adaptable to the sites.

Production of plant was depend on the capability of its vegetative to carry out the photosynthesis process as said by Subandi (2012c) that Substances which are produced in photosynthesis are glucose and oxygen as the by product.

3.4. Resistance to disease

Resistance level observation to main pests, was resistance to rust disease, virus, leaf pock and resistance to pod borer pests showed that NS Karawang variety had moderately resistance to rust disease. Leaf rust disease attack intencity attack data, showed on Table 6. Rust disease symptom of plant on age 50 day after planting (DAP), with the smallest disease intensity happened to Grobogan variety and kept hold out until 60 DAP, while on the age of 70 DAP, the rust disease intensity happened to NS variety. Durability of NS variety which was bigger, may caused by plant's genetic factor.

Table 6: Leaf rust disease average intensity on few groove or soybean variety which tested (%)

Variety	Leaf Rust Attack Intensity		
	Age of 50 DAP	Age of 60 DAP	Age of 70 DAP
NS	15.50ab	18.50b	20.00b
Anjasmoro	15.00ab	18.50b	33.00ab
Argomulyo	21.50ab	25.50ab	30.50ab
Orba	31.00a	35.00a	40.00a
Grobogan	12.50b	17.50b	23.50ab
Rajabasa	21.50ab	27.00ab	30.50ab

Explanation: Mean which are followed by the same letter in the same column are not significant difference based on Significant different range test p> 5%

Soybean rust caused by *Phakopsora pachyrhizi* is the most destructive foliar disease of soybean, and yield losses over 50% are common when environmental condition were conducive for disease

development (Hartman *et al.*, 2005). Environtment factor which had effect to disease development, which were moisture, temperature, and sunlight. Based Cook (1980) rust mushroom attack closely related to the wetness level of the plant. Soybean plant's older leaf will be bigger and wetter because covered by the leaves above it than younger leaf.

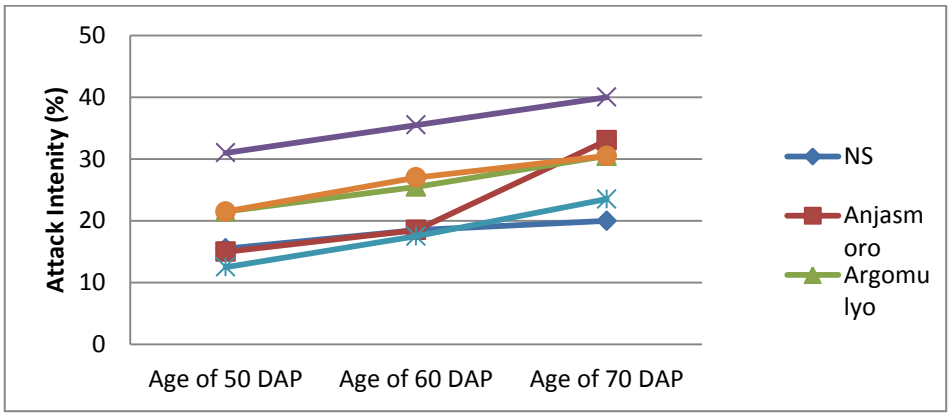

Figure 2: Intensity Development of Rust Leaf Attack

Increase of the disease intensity on every genotipe which tested, from the beginning through the end, caused by rust fungus characteristic, which generally attack the older plants. The older the soybean plant was, it will be more susceptible to rust fungus (Soekarno and Satari, 1987). This thing proven by Murdan *at al.* (1990) that it had more product inclination of uredospora *P. pachyrhizi*, if the plant has entered the pod stadium than other stadiums.

Few varieties resistance reaction and groove which tested to leaf rust disease, especially on the last observation on the age of 70 dap, showed increasement on resistance reaction based on IWGSR (Yang, 1977). That resistance reaction showed on Table 7.

Table 7: Average number of resistance reaction of few varieties and groove based on IWGS

Variety	Observation		
	50 DAP	60 DAP	70 DAP
NS	222	222	222
Anjasmoro	225	227	227
Argomulyo	227	225	227
Orba	227	228	250
Grobogan	222	222	222
Rajabasa	225	225	230

From Table 6 was known that NS and Grobogan varieties were moderately resistant. This thing showed from the number obtained, which 222, which means 1/3 of the leaf on middle position had shown a little unspora pock. Meanwhile other varieties included to susceptible. The tanecity difference caused by genetical difference from tested varieties. Plant height appears to be one of the factors that will determine differences in the severity of rust disease on soybean, correlation analysis showed that was significant negative correlation between plant height with the number of lesions (Sulistyo and Sumartini, 2016). The other research showed that Argomulyo and Grobogan and three lines namely K/I100//B63///G-7 (6.55 g), K/I100//B63///G-8 (6.15 g), and I100/B54//A-5 (5.85 g) namely K/I100//B63///G-7 (6.55 g), K/I100//B63///G-8 (6.15 g), and I100/B54//A-5 (5.85 g) as moderately resistant to rust disease. In this study, days to flowering and plant height influence the development of rust disease severity. There are three lines that have seed weight per plant significantly heavier than Argomulyo (4.97 g) and Grobogan (4.30 g). The high value of the

scales of seed weight per plant for the three lines is supported by high-performance plants with a lot of number of fertile nodes and pods. These three soybean genotypes potentially serve as genetic material to develop high yielding soybean varieties and resistant to rust disease Examined the effect of saccharin on the systemic acquired resistance (SAR) response of soybean to the fungus Phakopsora pachyrhizi, showed that saccharin applied as a root drench was more effective than the foliar spray treatment at inducing SAR, with increased resistance observed 1 day after application. Systemic protection against rust infection was still apparent 15 day after application of saccharin as a root drench. In contrast, foliar treatment with saccharin did not increase systemic protection until 15 day after treatment. When systemic protection was indayuced by the application of saccharin in either manner, there was no significant reduction of plant growth, except when plants were inoculated 15 d after the saccharin application as a root drench at the R1 stage of development (Pratibha *et al.,* 2011). Systemic acquired resistance (SAR) is a broad-spectrum defense system that is activated in plants upon challenge by certain pathogens and in response to other environmental stimulants. SAR is effective predominantly against biotrophic pathogens, and is controlled by a signaling pathway that depends on accumulation of salicylic acid (SA).

Based on laboratorium test NS Karawang local variety had high amount of protein which was 38,62 % and high amount of fat 18, 785%.

Test result of 33 people as respondent showed that respondent likeness level to 3 characteristics (texture, taste and colour) of NS soybean on "like" criteria as seen on Table 8. The acceptance of people to the quality of soybean, it was the product of people expertise to enhance wefare by means of science and technology they mastered. This is line with the opinion of Subandi (2012b) said Science is generally defined as the systematic observation of natural phenomena and their workings, and technology as it is defined as the application of science has influenced greatly human life.

Subandi and Abdelwahab (2016) said, people have to obtain harvest of plant if they want to survive in their life. So, conducting series of experiments to handle and manage the changing characteristics of climate become necessary to the believers Anyway, people have to obtain harvest of plant if they want to survive in their life.

Table 8: Respondent likeness level to soybean texture, taste, and colour characteristics

Variety	Score From 3 Organoleptic Character Test	Responds from Respondent to Taste Includes as Criteria				
		Like It Very Much >415,8-495	Like It >336,6-415,8	Enough >257,4-336,6	Doesn't Like It >178,2-257,4	Doesn't Like It Very Much 99-178,2
1. Anjasmoro	323					
2.Grobogan	344					
3.Argomulyo	309					
4.NS	349					

Explanation : *) = Organoleptik character which tested are 1) texture, 2) taste and 3) colour

4. CONCLUSION

Identification result had two NS Karawang local variants based on colour on the trunk, which were grey trunk fur and brown trunk fur. Variant which was purified for the next generation was one brown trunk. Description made based on UPOV standard. Adaptation test result showed that differences between NS Karawang and Anjasmoro, Argomulyo, Orba, Grobogan, and Rajabasa variety on height plant's height, number of productive trunk, number of pod for each plant, weight of 100 grains, yield per plant, yield per unit, and yield per hectare. NS Karawang had higher yield than Anjasmoro, Argomulyo, Orba, and Rajabasa but lower yield than Grobogan. NS Karawang

could be categorised as high yield potential with 2.08 ton/ha, amount of high fat (18.70%) and amount high protein 38.6%, big seed size and had sweeter taste. The plant was moderatery resistant to diseases such as leaf rust.

Funding: Department of Agricultural, Fishery, and Forestry District of Karawang
Competing Interests: The authors declared that they have no conflict of interests.
Contributors/Acknowledgement: All authors participated equally in designing and estimation of current research.

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