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Full Length Research Paper

Segregation and selection of observed yardlong bean (*Vigna sesquipedalis L. fruwirth*) to get expected lines of purple pod

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Abstract

The previous practical breeding on yardlong bean was gotten potential lines in purple pod, namely UBPU1, UBPU2 and UBPU, respectively. This purple colour, indicated anthocyanine compound in fresh pod, and it was role-play as antioxidant in human life. These lines had potential properties to be developed as prospective and new varieties. The segregated or expected lines had 1200 ones and it had gotten from previous practical segregation. These lines had a high variability in purple colour and quantitative characters. Mass selection method had applied to evaluate pod colour, length, surface and taste. Purple colour of pod was identified by RHS colour chart. There was high variability on observed qualitative and quantitative characters. All of them described a genetic variability. Variability of pod purple colour distributed from Deep Purplish Red (colour code: 95B), Dark Purple (colour code: 79A), Dark Purple Green Strip (colour code: 79B), Strong Red (colour code: 46A), Deep Red (colour code: 53A), and Dark Red (colour code: 59A), respectively. Although pod and stem were purple, but had variability of purple colour. This breeding had gotten 90 expected lines of purple yardlong bean and was evaluated their yield potential. It was gotten 15 candidates of new varieties.

Keywords: Yardlong bean, purple pod, selection, lines.

INTRODUCTION

Duration of extreme weather in Indonesia can stimulate a variability of vegetable diseases, so the daily needed of vegetable and protein of the community were disturbed. These conditions may soon be aided by providing an inexpensive source of protein but still healthy. The alternative source of vegetable protein and as a source of natural fiber was yardlong bean. Yardlong bean were planted in easy, tastes good and is favored by many different consumers. However, pod yield at the level of farmers just to 5.5 t. ha-1. The yield of yardlong bean Indonesia reaching 461.239 t fresh pods (Ministry of Agriculture, 2008) from harvest area 84.798 ha.

This yardlong bean study was based on the results of previous research that has been done the author since 2003 until the beginning of 2011. Research from 2003 to 2005, has produced some yardlong bean varieties which resistant to aphid borne mosaic virus and high yield (Kuswanto et al., 2005). Research from 2006 to 2007 had produced new varieties which tolerant to aphid and high yield (Kuswanto et al., 2007). The other research in 2008 had also produced a varieties of yardlong bean which resistant to major diseases and pests and also high yield (Kuswanto et al., 2009). During in 2009 has been carried out the final stage of purification and evaluation of selected lines to be tested as new varieties. In 2010 have been performed to test the adaptation of expected lines and had gained 6 new varieties that are registered to the Ministry of Agriculture (Kuswanto and Waluyo, 2010). In 2011 has been conducted in order to test of NUUS (novelty, unique, uniform, stabile), to get the plant varieties protection (PVP). Finally, in 2012 has been obtained five certificates of plant breeders ' rights.

Based on the series of research, conducted until 2010, and had obtained as a mixture of potential lines that needs to be developed. The lines appearance still diverse, but it had purple pods and hold kept to 5-6 days (Akbar, 2012). The purple colour was thought to contain

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an anthocyanine which were useful as antioxidants. The pod purple plant also tolerant to pests and disease, as well as tolerant of water stress conditions. The leaves and stems have hairs along the surface. Purple pods have a thicker skin and hard so disliked by pests. These characters also cause purple yardlong beans more resistant than others. These lines need to be improved so that it can serve as potential of new superior varieties.

In early 2011, all lines of purple pod had identified as the initial breeding to get expected new lines. Based on those results, it needs to be followed by selection of purple pod lines. The purpose of the research was to produce the expected lines of purple yardlong beans.

RESEARCH METHODS

This research was carried out at the Experimental Station, Faculty of Agriculture University of Brawijaya, located in the village of Jatikerto, district Kromengan, Malang, Indonesia, altitude 330 m above sea level, rainfall 120 mm, average daily temperature 27^{o}C. The research was carried out from November 2011 to October 2012. This activity was one of a series of studies in the framework of the plant breeding of yardlong bean varieties. The materials used in this study were expected lines of purple yardlong beans research (Kuswanto et al., 2011). They were segregated from UBPU1, UBPU2, UBPU3 lines. The UBPU1, UBPU2 and UBPU3 planted in 400 plants, so that altogether 1,200 expected lines. The check varieties were Brawijaya 1 and Parade. All expected lines planted in bulk on the land side by side. Each 400 plants of UBPU1, UBPU2 and UBPU3 planted in 20 rows and each of rows contains 20 plants. During the cultivation, the natural selection occurred due to the influence of biotic and abiotic factors.

Mass selection method was used to select expected lines. Selection based on pods colour, pods length and surface of the pods. Observations were carried out individually for the healthy plants, not stricken with pests and diseases. The observed variables include age of flowering (dap), the number of flowers, the number of pods, fruit set (%), age of harvest (dap), the number of pods cluster (cluster), pod length (cm), and save length of fresh pods (hours). Data analyzed with analysis variance, standard deviation, and the average of quantitative observations. From the results of the analysis on each populations and control varieties, it will get the value of heritability lines each others.

$$h^2 = \frac{\sigma^2 lines - \sigma^2 control}{\sigma^2 lines}$$

(Note: h2: heritability, σ2: variance)

Analysis of genetic gain (response of selection) performed on each lines. Genetic gain was calculated with the formula:

$\Delta G = h^2 \, k \, \sigma_{p.}$ (Singh and Chaudhary, 1979)

(Note: ΔG: genetic gain, h^2: heritability, k: selection intensity (5%), σ_p: deviation standard)

Selection value for lines each other, calculated with formula:

$Xs = X.. + k \, \sigma_p$

(Note: Xs: line mean, X..: grand mean, k: 2,06, selection intensity 5%, σ_p : deviation standard of phenotype. The selected lines were lines had more than Xs)

RESULT AND DISCCUSSION

The colour diversity of the purple pods

Based on the observations on purple pods, there was diversity of purple pods. The observation pods colour based on the standard test hues using the RHS colour chart. In General, the colour purple can be grouped into 6 groups of colours, namely Deep Purplish Red (colour code: 95B), Dark Purple (colour code: 79A), Dark Purple (colour code: 79B) with edge of striped green, Strong Red (colour code: 46A), Deep Red (colour code: 53A), and Dark Red (colour code: 59A). Difference in purple colour allegedly associated with anthocyanin content. The more anthocyanin contents the darker of pods colour. The special case it even to blackish. Genetically, this colour diversity was very beneficial for the development of new varieties. Here were presented the sixth images of colour type of observed pods. (Figure 1)

Genetic variability

There was a high genetic diversity among expected lines. Heritability analysis showed that nearly all the characters had important values, quantitatively, more than 50% (Table 1). This heritability indicates opportunity for selection which can be done on each lines population. The higher value of the heritability, the more effective the implementation of selection (Nasir, 2001). The number of pods, was the main selection character had the most effective serve as selection criteria. In addition to having the highest value of heritability, this character could be easily observed visually. Selection was based on the number of pods were easy to do, because the number of pods can be found easily and as a component of determining crop yield. The more of pods number, the higher the yield. However, the selection was based on the number of pods should also consider the length of the pods. Length pods also had an average of heritability more than 50%. The selection base on the pods number and length will become more effective.

Selection based on the amount of flowers, the clusters number of flowers and fruit set as well can run effectively, if a controllable amount of flowers that will probably fall down. The more flowers it will produce a lot of pods.

Figure 1. Difference of pod colour: (watch direction): Grayish Purplish Blue (103A), Dark Purple (79A), Dark Purple (79B), Dark Red (59A), Deep Red (53A) and Strong Red (46A).

Table 1. The heritability value of three mix populations of purple yard long bean.

		UBPU1		UBPU2		UBPU3	
Characters	σ_e^2	σ_g^2	h^2	σ_g^2	h^2	σ_g^2	h^2
Flowering age	11,2	38,99	0,71	37,58	0,7	37,04	0,69
Flower number	61,99	446,75	0,86	438,02	0,85	553,41	0,88
Harvest age	13,34	25,52	0,47	24,03	0,44	18,86	0,29
Pod number	15,96	237,08	0,93	316,7	0,94	320,83	0,95
Fruit set	70,15	403,87	0,82	291,31	0,75	309,16	0,77
Cluster number	8,2	102,57	0,91	89,21	0,9	82,65	0,9
Pod length	35,72	67,82	0,47	96,04	0,62	47,97	0,25
fresh age	374,42	1462,14	0,74	1036,42	0,63	538,9	0,3

But, if there are pods that fall down, then the number of flower would not specify the number of pods. The age of flowering and harvest age can also be an effective selection criteria, because the value of heritability. However, these characters were not used when not associated with the pods of the plant.

Based on the results of the qualitative observation and quantitative analysis of the characters, and then do the selection of expected potential lines. The first selection conducted against the lines of purple pods. The next selection was based on the number of pods, pods length, pod surface, and taste of the pods. The pod number and length were the main criteria in the implementation of the selection. Although the purple pods, but the smooth skin surface chosen were not hairy. Not all pods had a smooth skin. The pod taste was based on the results of organoleptic test. The pod was easily broken, it feels crisp and not bitter, was selected as a candidate of expected lines.

Based on some selection criteria, finally obtained 90

Table 2. The genetic gain of quantitative observed characters.

Quantitative characters	UBPU1		UBPU2		UBPU3	
	Mean	Genetic gain	Mean	Genetic gain	Mean	Genetic gain
Flower age (days)	49.4	7.83	50.33	7.57	49.92	7.47
Flower number	55	32.03	57.2	31.62	67.46	36.76
Harvest age (days)	59.23	4.24	59.6	3.83	59.53	2.23
Pod number	31.13	25.27	37.06	29.74	42.64	29.95
Fruit set (%)	57.95	29.22	64.41	22.8	62.32	23.92
Cluster number	27.9	16.39	25.17	15.09	29.41	14.41
Pod length (cm)	31.32	6.85	34.63	10.83	29.66	3.11
Fresh pod (hours)	121.51	50.06	141.03	36.19	107.98	12.46

Table 3. The list of the new variety candidates.

Varieties Name	Pod number	Pod length	Seed number	Pod weight	Pod colour
UBPU1-55	33.18	28.36	13.67	214.86	dark red (2 green lines on pod)
UBPU1-41	25.23	41.90	15.74	199.74	dark red (1 green line on pod)
UBPU1-130	16.13	50.18	14.94	164.45	dark red
UBPU1-139	23.09	44.57	12.76	296.64	dark red
UBPU1-222	29.80	31.11	13.06	270.37	dark red
UBPU1-365	26.51	37.74	18.20	147.00	dark grayish purple (purple stem)*
UBPU2-41	24.07	44.15	14.50	251.86	grayish reddish brown
UBPU2-52	20.50	46.37	14.16	205.35	strong red
UBPU2-202	29.53	53.51	44.51	326.72	dark red
UBPU2-237	30.96	40.67	12.14	268.25	deep red
UBPU2-400C	36.57	30.11	8.97	148.33	dark red
UBPU3-45	18.87	28.53	15.52	101.30	dark grayish reddish brown (purple stem)*
UBPU3-286	22.89	37.64	14.74	186.97	dark grayish purple
UBPU3-153	32.92	33.23	11.83	268.30	dark grayish reddish brown
UBPU3-194	28.30	28.63	12.00	199.73	dark grayish reddish brown (2 green lines on pod)

expected lines of purple yardlong beans, which were selected from the 1,200 lines. Furthermore, all of the selected lines will be tested on its yield potency and selected further to choose lines that could potentially be tested their adaptation and be released as new varieties.

The genetic gain

Expected genetic gain was a value increasing of the observable characters when doing selection against such characters. If the value of the genetic gain was high, it means there was a great opportunity to do the character improvement through selection (Buckley and Graham, 2001). The magnitude of the value of the heritability will determine the magnitude of the value of this genetic gain. Table 2 describes the variability of the expected genetic gain (ΔG) on each observed characters.

Table 2 determined the value added of quantitative characters look when performed the selection. Base on the analyzed heritability value (Table 1) and ease of selection implementation, the number of pods was the character which the most effectively enhance the yield of purple pods yardlong bean. When the selection was made based on the number of pods and considering the pods length, then be obtained increased yield significantly. In theory, the number of pods will increase 70.23% (UBPU3), 80.24% (UBPU2) and 81.18% (UBPU1) when the selection was made based on these characters. The cluster number of flower can also provide added high value, but the implementation of the selection were influenced by the fruit set, so it becomes less effective. The age of plants can be important considerations in an attempt to get a dwarf plant. The value of the genetic gain of these characters was quite high and the implementation of the selection was easily.

The New Candidates of Varieties

Base on observed pod colour, analysis of quantitative characters, market demand, fresh pod taste, boiled pod taste and performance of pod surface, it get selected expected lines to be candidate of new purple varieties. The new varieties will be tested by NUUS test method (Nurdini et al., 2012). Table 3 determines the list of the new varieties candidate.

CONCLUTIONS AND SUGGESTION

There was a diversity of purple pods colour and can be grouped into six purple clusters. There were genetic diversity on all quantitative characters and the number of flowers can be made into a main character in implementation of selection. It obtained 90 expected lines of purple yardlong bean. It was gotten 15 candidates of new varieties. The candidates of new varieties of purple yardlong bean must be evaluated in adaptation and yield potential observing, in order to be immediately retrieved superior varieties of this.

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