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HYBRID VIGOR OF CROSSING AMONG JAPANESE AND INDONESIAN SOYBEAN Mohammad Setyo Poerwoko Faculty of Agriculture University of Jember, East of Java. Indonesia setyopoerwoko@yahoo. com ABSTRACT The magtitude of hybrid vigor is normally presented in term of heterosis (H, superiority 9t the F 1 hybrid over than its parental mean) and heterobeltiosis (Hb, superiority of the F 1 hybrid over its better parent).

The data were collected on averaged seed yield/plant, number of pod/plant, number of seed/plant, 100 seed weight, number of fertile node in main stem/plant. and plant height. Several cross showed heterosis over than the mid parent and better parent. Crosses showing heterosis for seed yield/plant also showed heterosis for number of pod/plant. number of seed/plant (UNEJ-1xKeohsiung).

However, only Kaohsing x Malabar, and Malabar x UNEJ-2 for seed yield/plant expressed heterobeftiosis.Superiority over the mid parent for seed yield/plant ranged from 3% to 31%. and that over the better parent ranged from 2% to 58%. The highest heterosis over the mid parent was Malabar x UNEJ-2 and better paret was shown in the cross Kaohsing x Malabar.

The best three hybrid selected for next generation selection (breeding for high yielding and early maturity) were Kaohsiung-3 x Malabar, Malabar x UNEJ-2, Malabar x East of Jsva-2. In self pollinated crops, hybrid seed can be produced using a male sterile line as a female parent. The detected seed yield heterosis must be reasonably high to compensate for cost of seed production.

Key word: Heterosis, Heterobeltiosis, soybean, hybrid vigor INTRODUCTION Soybean, Glycine max, L. Merrill was a· crucial source of protein in Indonesia. Soybean is a crop with a harvest ripe age between 70 to 85 days. The increase results mainly from an increase in harvest area. Increases in prOductivity result not easily achieved through an increase in acreage planted.

The use of hybrid cultlvars can increase the power limitations of the results of pure line cultivars. Hybrid varieties have contributed greatly to the increased production of various crops, including major food crops such as rice and com. Commercial exploitation of heterosis is one of the strengths and · extensive development on seed production.

Heterosis breeding for results has bee , n ~onducted on various crops, including cross-pollinated plants, and plant species at self-pollinated plants. Exploitation of heterosis to increase productivity in legume seeds, as well as in other plants, relies on three main factors: (1) the amount of heterosis, (2} the feasibility to produce hybrid seeds for large-scale production. and (3) type action of existing genes. Heterosis could improve yield, size, and number of plant parts.

component-chemical components , and nature's resistance to disease. The hybrid is a type of crop produced from .the merger of gametes is not the same as or derived from pairs of genes heterozygote for certain characters . Heterosis and heterobeltiosis expressed in percentage without going through the tests of significance.

If the standard error associated with each value was high, the high heterosis may be statistically not significant different. thus the data obtained did not meet the requirements of seed companies that produce commercial hybrid seed. The main obstacle to the utilization of heterosis in soybean is a crop that between the two elders is increasingly distant.

Ihis is associated with the mechanism of heterosis due to the heterozygote alleles in hybrid offs_pring(F1). In this regard. the researcher tried to cross between Indonesian soy with soy Japan. Based on the results of the study was first (Poerwoko et al.. 1998) have been obtained soybean genotypes Unej Unej-1 and-2 are high yielding and properties of soybean leaf rust resistance are moderate.

MATERIALS AND METHOD The material used is the five soybean: (1) Unej-1, (2) Unej-2, (3) Variety Malabar, (4) Japanese Soybean cuttivar Ryokkoh. R-75), (5) cultivar Kaohsiung-3, and (6) cultivar East of Java-2. Genotype Unej-1 and Unej-2 is soybean germplasm of high yielding, rust resistant obtained from previous studies (Poerwoko, et al., 1998).

Malabar varie-ties are a source germplasm . early age, while the Ryokkoh, R-75, Kaohsiong-3 and the East of Java-2 are edamame cultivars with large seed size (weight of 100 seeds on top of 20g). To assemble the hy°brid method is used Griffing (1956) through dialel crossing 6x6.

The formula used to determine the, value otheterosis and heterobeltiosis as used by Soehendi and Srinives (2005) as fol~o~s. Par each P1 C1'0U.,, percent heterosia (%H) and heterobeltiosia (%Hb) for a plllticular ll'ait w-. ·ca.1cu1aled ... follows : %H • {F, - MP)ll MP • and When,; %Hb. (P, - P,)x 1001F .. n,can obeervatfon of'lhe F, prosenlu ft -om tbe total ofn, plants, mean observation or both prent &om n2 + n, plants, and me,an obllervation ofthcs parent ft-om n2 plants for P., and n:t plants fOf' P1. Sipiftcanoe or H and Hb weft determined by a t-tat u follows: test (or H P, - MP • and s. t-teat for Hb F,-P. s...,

where SH IUld S... are the standard error of cstimata or H and Hb which can be derived as ehown in the altached note. Tlae ....,_ of ftoedum (41) for each test was obtained by summina up the df of each pnaation involWld in the estimate. Thua. tho 4/'far temna Hi (n,·l)+(n, -l)+(n, -1). and tho 4/'fw tostina Hb is (n. - l)+(n 1 -1), i - 2 or 3. dependina on whether the high pment is Paar P2.

Derivation (offspring) from the use of formulas and Heterobeltiosis Heterosis in accordance with the criteria according to Soehendi and Srinives, 2005, as follows Nott! o" d,rivotinn method for S 11 and Sup If 12 i:,-Q:,+ii,). 2 F, _ r, _ P, . 2 2 Using the property of expectarron (Steel and Torrie. 1980~ Chapter 5. topic S. I 0) then. VananceorH Var(F, - ~· - ~'} - VP, VP, VF, .. --·--· 4 4 (assumina no covariation between generations).

VF 1 + VP, + VP 1 , n, 4n 1 4n, 2~ • SSP, ... s_s_P..._,_ n,(n,-J) 4n,(n 1·1) 4n 1(n,·l) Wlu:rc vi:,. VP,. •nd VPJ arc the variances or the mean or each gcncration; and VF,. VP,. VP,. SSP,. SSP, and ssr-, arc variances and sums or squares of the specified generations. respectivel y. Then. the standard error of estimate of H (or Su ~vananccof 1:1. In the same manner.

variance of Hb can be obtained from Variance or Hb Var (F, · P 1). VF 1 VP, n, + n, - ssF, + SSP, n, (n, • I) n,(n, • 1) and S,n, • Jvanancco(Hb . . .. (g} Per Plant Plant Weight Nodes (cm). UNEJ -1 (1) 4. 95±1. 14 60. 31t18 .53 54.00±21. 25 8. 55±0. 00 8. 00:t3. 08 49.50±8.93 2 UNEJ -2 (2) 3. 18:t:0 .87 35.04:t10.85 43. 20±19. 57 8. 16±0. 00 9. 60±2.73 53.76±6. 97 Malabar (3} 8. 27±2.50 72.75:t:13 . 50 105.50:1:54.4 9. 25±0. 00 11. 50:.t:1 .66 51 . 38:t:7.44 3 3 ,4 Ryokkoh (4) 10. 08±1.37 28.25:t9.52 38.75±14 .15 24. 98:tO .OO 7.75±2.49 27. 6:t9. 15 5 Kaohsiung 3 (5) 8. 57±2. 31 31 . 94±6. 32 36.00±13.66 19 . 57±0.

00 6. 75:t0.83 32. 23±4. 15 10. 04±2. 96 24. 44:t:1 .55 32 . 22~.28 25. 30:t:0 . 01 5.33t1.70 28. 80:t:17 . 13 6 East of Java 2 (6) 7 1 x 2 3. 93:t0. 48 60.12:t:19.88 31. 79±9. 22 5. 09±0. 00 13.45±4.55 80. 5±6. 5 8 1 x 4 10. 24:tO . OO 74. 00:tO.OO 144._ 00:tO .OO 8. 28±0. 00 13.00±0.00 69. 00:t:O . OO 9 1 x 5 7. 57±2. 12 42.95:t2.95 75.81:l:7 . 67 1 1 . 89±0.00 8.75:t0. 43 56. 08±10. 57 10 2x6 2.65:tO.OO 100.00%0 . 00 70.001.0.00 3. 79±0.00 15.00%0 .00 85. 00:t:O . OO 11 3 x 1 5.72±1. 45 121.

56±30. 94 81 . 2:t.24 .5 10 .30±0. 00 12.80±1 . 17 74. 61±6. 91 12 3x2 12.74t1 .~ 86. 75:t:6.94 112.25:t.22.5 7 12 . 17:.t: O . OO 9. 75%0.43 63. 00±13 .97 13 3x6 13.93:t1 .11 95. 44±7. 67 178.33:tJ 1.2 6 11 . 05:tO . OO 15.33:.t:1.25 59. 24±4. 08 14 4x2 6. 57±1.93 43.56±15.35 32.89:t7.34 21. 21±0.00 6. 40:t 0.49 38.60±6.31 15 4x5 1 . 45:t0.40 29.50:5.50 31 .25±3.75 5.26±0. 00 6.~0 . 00 44. 00±4. 00 HS 4x6 11.40±1 . 63 41.00±6. 00 61 .13:t3. 88 19. 34±0. 01 9.50±0.50 29. 70±1 .80 .

RESULTS AND DISCUSSION Observations for six agronomic properties elders. F 1 and F, reciprocal presented in Table 1 Table 1 . Yield and Yield Component of Agronomic Characters F, and Six Parents '\ Seed Yield r pod L Seed Per 100 Seed I Fertile Plant height No. Genotype Per Plant 4. 39±1. 13 22.00±4. 32 21. 81:t:5 . 31 18.68±0. 01 5.00:t0.82 28. 89:.t: 4. 32 17 5x1 18 5x3 13.55:tO.OO 35.00±0. 00 65.00±0 . 00 27. 00±0. 00 9.00±0.00 31. 50:t:O .

OO 19 Sx4 4. 22:t0.67 33.92±3.60 28. 28:t3. 36 16 .1 9:tO . OO 6.80±0. 75 41. 28±1.57 20 Sx6 7. 33:.t:1 .32 36. 68t15 . 29 27.95±4 . 21 26. 57±0. 00 6.80±0. 40 38.67:1:2 . 14 21 6x3 9. 72±1. 25 35.88±1 . 87 40.84±11. 26 26.47:t: 0. \)5 7. 20:t0 .40 35.61±5.10 22 6x4 7. 67:t1. 65 31. 72:t 6. 02 33. 81±10 . 01 24. 10±1.43 7. 25±1. 09 32. 33±5.29 Weight of seeds per plant for Unej-1. Unej-2, Malabar, Ryokkoh (R-75). Kaohsiung-3, and East of Java-2,·respectively, 4. 95, 3. 18, 8.27, a .

10: 8:57, and 10: 04 g I plants. Kaohsiung-3 x Malabar {15%), and Malabar x East of Java-2 {13%). Hybrids Malabar x Unej-2, besides having a mean value of heterosis based on both parent is high {31 %), supported also. b~ the value of heterosis pods per plant number (15%), number of seeds per plant (13%), weight of 100 seeds (10%) and plant height 5%).

As for the nature of the number of fertile book, it turns out heterosis value {·2%), but this trait proved to have different degrees of closeness unreal Table 4, r = 0. 093ns. F1 and reciprocal F1 's best in a row is Malabar x East -- - - - - --- - · 4 · - ·-· -- - _. r Fertile Plant height Nodes {cm) of Java-2 (13.93 g I plant), Kaohsiung x Malabar (13:55 g I plant), and Malabar x Unej-2 (12.74 g I plant).

Furthermore, Table 2 presents the value of heterosis based on the average of the two mid-parents. Table 2. Heterosis (%) Above Mid-Parent Several Crossing for Six Agronomic " Character Seed No Recombinants Yield r pod r Seed 100 Seed ~eight Per Plant Per Plant Per Plant (g) 1x2 -0.01 0. 07 -0.09 -0.10 0. 13 0.14 2 3 1x4 0.09 0. 17 0.53 -0. 13 0. 16 0.20 1 x 5 0.07 -0. 02 0.17 ·0.04 0. 05 0. 09 4 2x6 ·0.15 0. 59 0.21 ·0.19 0.25 0.26 5 3x1 ·0.03 0.21 0. 00 0.04 0.08 0.12 6 3x2 0. 31 0 15 0. 13 0. 10 -0.02 0. 05 7 3x6 0.13 0.24 0.40 ·0.09 0.21 0.12 8 4x2 0.00 0. 09 -0.05 0.07 -0.07 ·0.01 9 .4x5 -0. 21 0.00 -0.04 -0.19 -0. 03 0. 12 10 4x6 0. 03 0. 14 0. 18 -0. 06 0. 11 0. 01 11 5 x 1 -0.09 -0. 13 -0.13 0.08 -0. 08 -0.o7 12 5x3 0. 15 ·0. 08 -0.02 0.22 0.00 -0.06 13 5x4 -0.14 0. 03 ..Q.05 -0.07 ·0; 02 0.09 14 5x6 ·0.05 0.08 -0. 05 0.05 0. 03 0. 07 15 6x3 0.04 -0. 07 -0.10 0. 13 -0. 04 -0. 03 16 6x4 -0.06 0. 05 -0.01 -0.03 0. 00 0. 04 Average 0. 00 0.09 0. 07 -0. 01 0.05 0. 07 Stand Dev. 0.12 0. 16 0. 18 0. 11 0. 10 0.

09 1 = UNEJ-1; 2 = UNEJ-2; 3 = Malabar: 4 = Ryokkoh {R-75); 5 = Kaohsiong-3 {KS-· 3); 6 = East of Javs-2 (E0-2) Table 3. Yield and Yield Component of Agronomic Characters F1 and Six Parents Presents (Table 1), the heterosis (Table 2} and the value heterobeltiosis in Table 3), and the value of the correlation between the six agronomic trait Table 4).

then it can be determined at least one crossing who will be able to proceed to the assembly of new soybean varieties. Three hybrid q,mbinations for each agronomic trait values in Table 3 indicated in bold (bold). Three hybrids with the highest value on heterobeltiosis best trait grain yield per -plant, respectively, Kaohsiong-3 x Malabar (58%), Malabar Unej-2 (54%), and Malabar x East of Java-2 (39%). -0.21 0.00 -0. 41 -0.40 0.40 0.50 0.02 0.23 0.65 -0.03 0.63 0.39 -0.12 - 0.01 0.40 -0.39 0. 09 0.47 -0.74 1.85 0.62 -0.85 0. 56 0. 58 -0.31 0.67 -0.23 0.11 0.11 0.45 0.54 0.19 0.06 0.32 -0.15 0.17 0.39 0.31 0.69 -0.56 0.33 0.15 -0.35 0.24 -0.24 -0. 15 -0.33 ·0.28 -0. 86 0.08 -0. 19 -0. 79 -0.16 0.36 0.13 0.45 0.58 -0.2<4 0.23 0.03 2 1.000 -0.606 3 1.000 ' 4 1.000 5 6 r pod Plant Characters Table 3.

Heterobeltiosis (%) Six Agronomic Character Based on High Parent Several Crossing Seed No Recombina Yield r Seed Per 100 Seed r Fertile nts Per Plan1 Per Plant Weight Nodes height (g} Plant (cm) 1 x 2 2 1x4 3 1x5 4 2x6 5 3 x 1 6 3x2 7 3x6 a 4x2 9 4x5 10 4x6 11 5 x 1 -0.49 0.64 -0. 60 -0.05 -0. 38 -0.42 12 5x3 0.58 0.52 -0.38 0.38 -0. 22 -0.39 13 5x~ -0.58 0.06 -0.27 -0.35 -0.12 0.28 14 5x6 -0.27 0.15 -0.22 0.05 0.01 0. 20 15 6x3 0.13 0.51 -0.61 0.05 -0.37 -0.31 16 6x4 -0.24 0.12 -0.13 -0.

18 -o.oe 0.12 Average -0.15 0.16 -0.01 ·0.19 0.04 0.15 Stand Dev. 0.41 0. 55 0.46 0.34 0.31 0.32 1 = UNEJ-1; 2 = UNEJ-2; 3 = Malabar; 4 = Ryokkoh (R·75); 5 :. Kaohsiong-3 (KS-3); 6 • East of Java-2 (E0.2) Table 4. Correlation Matrix among Six Agronomic

Characters Seed Yield/ Pod/ Seed/ 100 Seed Fertile Plant Height Agronomic Plant (g) Plant ~lant Weight (g) Nodes (cm) 1 2 3 4 5 6 0.698 - .. .. 0.836 0.813 1.000 -0.223 nt 0.510 0. 0.093nt -0.2'23nt .. 0.693 .. -0.637 0.533 .. -0. 803 1.000 0.800 .. 1.000 Tabler (5%, db. n-2 = 0.497), r (1%, db. n-z = 0.623) ns: non significance difference significance difference -: highly significance difference Hardan ingsih dan Soegito. 1994.

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