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USE OF REGRESSION ANALYSIS IN VARIETY SELECTION

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Abstract

Variety comparisons by growers are critical decision for each production year. Summarizing by averaging together tests across a geographic area will determine which variety had the highest yield over all the locations tested, but may not determine the best variety to plant on any particular farm or field environment. The procedure outlined here allows relative variety performance to be measured across a range of yield environments. Use of the D&PL Performance Database as a data source, followed by linear regressions of lint yield and crop values of "Variety 1" on "Variety 2", was able to determine what portion of the yield spectrum and crop value spectrum each variety is favored. In the examples used, DP 451 BR is favored over ST 4892 at yield levels up to 746 lb/acre and crop values up to $571 / acre. PM1218 BG/RR was favored over ST 4892 BR at yields up to 1337 lb/acre and crop values up to $817 / acre. PM 1218 BG/RR was also favored over DP 451 B/RR over the normal range of cotton yields, and up to $871 / acre crop value. This approach does not remove the need to assess varieties for adaptation to local conditions such as soils, diseases, and other factors, but does allow a broader view of variety performance that typical multi-location and multiyear summaries do not permit.

Introduction

Variety selection by cotton growers, assisted by crop advisors, consultants, extension personnel, and company representatives, has become a more difficult task each year with the increase in the number of varieties offered commercially and the number of transgenic traits available, as well. Much data exists to support a growers decision of what varieties to plant on his farm, but summarized data over multiple test locations and years does not portray the performance of varieties across a range of conditions or yield environments. Summarizing by averaging together tests across a region will determine which variety had the highest yield over all the locations tested, but may not determine the best variety to plant on any particular farm or field environment. The use of simple linear regressions of the yield of one variety over the yields of a comparison variety is proposed as a method to improve a growers understanding of variety performance across a range of conditions. Three examples of comparing two varieties for both yield level and crop value across a range of conditions are included.

Materials and Methods

A series of variety comparisons were made using the Delta and Pine Land Company Performance Database of the Agronomic Information System, comprised of all data sources (D&PL tests, University variety tests, and Extension variety tests), and all years available data in the database as of December 21, 2001. The data was limited to Mid-South states of Missouri, Tennessee, Arkansas, Mississippi, and Louisiana to compare varieties that are adapted within the region and avoid data from regions that selected varieties are not adapted. For this exercise this region was selected to have a large dataset for a meaningful analysis. The following three head to head comparisons were made: 1) DP 451 B/RR vs. ST 4892 BR; 2) PM 1218 BG/RR vs. ST 4892 BR; and 3) PM 1218 BG/RR vs. DP 451 B/RR. All possible head to head comparisons were selected from the database for each pair of varieties being compared, then a simple linear regression of lint yield and crop value were completed by regressing Variety 1 on Variety 2. The crop values are calculated using the 2001 crop USDA Crop Loan chart and a base price of $0.50 per pound. The individual data points, the linear regression line, and the 1:1 line (where the yield of the two varieties are equal) are all graphed for each comparison.

Results and Discussion

DP 451 B/RR vs. ST 4892 BR

The head to head averages for this comparison indicated very similar performance for the two varieties (Table 1). ST 4892 BR had 18 lb./acre better yield performance, but DP 451 BR had $7/acre greater crop value. The ST 4892 BR had higher numerical yields in 62% of the head to head tests while the DP 451B/RR had longer staple, lower micronaire, and better leaf grade in enough plots to improve the crop value on the DP 451 B/RR to greater than the ST 4892 BR.

The regression analysis of this head to head comparison (Figure 1) shows that the yield of DP 451B/RR is favored in yield environments less than 764 lb/acre, and ST 4892BR yields are favored in yields greater than 746 lb/acre. One application of this analysis for a grower is that in fields that typically yield in the 1 bale to 1.5 bale per acre range, DP 451 is the preferred variety, based only on yield. When the crop value regression is also considered, the advantage of the DP 451 B/RR moves up the scale

(Figure 2). Based only on crop value, DP 451 B/RR produced greater crop value per acre at environments up to $571 / acre. Using $.52 / pound base price, this pushes the DP 451 advantage up to over 2 bales per acre. ST 4892 BR has greater yield and crop value at the higher yield and crop value environments, according to this analysis. The grower or crop advisor using this approach would place varieties in fields with the correct range of yield and crop value defined by this analysis.

PM 1218 BG/RR vs. ST 4892 BR

The head to head comparison of PM 1218 BG/RR vs. ST 4892 BR indicated a 95 lb /acre lint yield advantage and $49 / acre crop value advantage to PM 1218 BG/RR (Table 2). PM 1218 BG/RR outyielded ST 4892 BR in 68% of the comparisons, while the ST 4892 BR had longer staple, greater strength, and slightly lower micronaire. The regression analysis of the lint yields for this head to head comparison (Figure 3) shows that yield environments up to 1337 lb/acre favored the performance of PM 1218 BG/RR. The regression for crop value had very similar results to the lint yield analysis. PM 1218 was favored more strongly at the lower crop values levels, and was favored up to $817 /acre (Fig. 4). Utilizing this approach a grower would need to match his field production and crop value levels to these regression lines and plant the appropriate variety in the appropriate field environment. In this case PM 1218 BG/RR in the Mid-South is favored in trials with yields up to 1337 lb/acre or values up to $817 / acre.

PM 1218 BG/RR vs. DP 451 BR

This head to head comparison differs from the previous two comparisons. The average performance of PM 1218 BG/RR is 116 lb/acre higher than DP 451 B/RR and $37 / acre higher (Table 3). In this case the regression line of the PM 1218 BG/RR yields does not cross the 1:1 line in the normal range of cotton yields (Figure 5). In other words, this analysis shows that across the range of yield environments tested in the mid-South, PM1218 BG/RR had yields higher than DP 451B/RR. Only 16% of the tests did DP 451 BR out-yield PM 1218 BG/RR. The fiber quality of the DP 451B/RR is better overall, than PM 1218 BG/RR, with longer staple, lower micronaire, and slightly greater fiber strength. The differences in quality resulted in a $37/acre average crop value advantage for PM 1218 BG/RR. The crop value regression analysis (Figure 6) shows that the value of DP 451 B/RR does overtake the value of PM 1218 BG/RR, but not until a crop value of $871 /acre. At a loan value of $0.52 / lb, this loan value is not reached until over 1500 lb lint /acre. This analysis would indicate that PM 1218 BG/RR has both a lint yield and crop value advantage over DP 451B/RR over most of the yield and crop value spectrum.

Summary

Summarizing variety tests across a range of test environments may result in losing information regarding what yield environments that a variety may perform best. The procedure outlined here allows relative variety performance to be measured across a range of yield environments. Use of the D&PL Performance Database to develop linear regressions of lint yield and crop values of Variety 1 on Variety 2, is able to determine what portion of the yield spectrum and crop value spectrum each variety is favored. In the examples used, DP 451 BR is favored over ST 4892 at yield levels up to 746 lb/acre and crop values up to $571 / acre. PM1218 BG/RR was favored over ST 4892 BR at yields up to 1337 lb/acre and crop values up to $817 / acre. PM 1218 BG/RR was also favored over DP 451 B/RR over the normal range of cotton yields, and up to $871 / acre crop value. This approach does not remove the need to assess varieties for local soils, diseases, and other factors, but does allow a broader view of performance, that typical multi-location and multiyear summaries do not permit.

Table 1. Head to Head Comparison of DP 451 B/RR vs. ST 4892 BR

Variety	Lint Yield	% Wins	Staple	Strength	Micronaire
DP 451 B/RR	847	38%	35.0	27.1	4.3
ST 4892 BR	865	72%	34.6	28.4	4.4
No. of Tests	112	112	93	93	93

Variety	Leaf Grade	Turnout %	Uniformity	Value
DP 451 B/RR	1.8	33.8	82	$423
ST 4892 BR	2.5	37.2	82	$416
No. of Tests	66	112	93	73

Table 2. Head to Head Comparison of PM 1218 BG/RR vs. ST 4892 BR

Variety	Lint Yield	% Wins	Staple	Strength	Micronaire
PM 1218 BG/RR	955	68%	34.1	26.9	4.45
ST 4892 BR	860	32%	34.6	28.3	4.41
No. of Tests	103	103	83	83	83

Variety	Leaf Grade	Turnout %	Uniformity	Value
PM 1218 BG/RR	2.3	37.8	82.0	$460
ST 4892 BR	2.4	37.4	82.3	$411
No. of Tests	59	103	83	64

Table 3. Head to Head Comparison of PM 1218 BG/RR vs. DP 451B/RR

Variety	Lint Yield	% Wins	Staple	Strength	Micronaire
PM 1218 BG/RR	965	84%	33.9	26.8	4.5
DP 451 B/RR	849	16%	35	27	4.3
No. of Tests	156	156	124	124	124

Variety	Leaf Grade	Turnout %	Uniformity	Value
PM 1218 BG/RR	2.2	37	82	$457
DP 451 B/RR	1.8	33.4	82	$420
No. of Tests	91	140	124	101

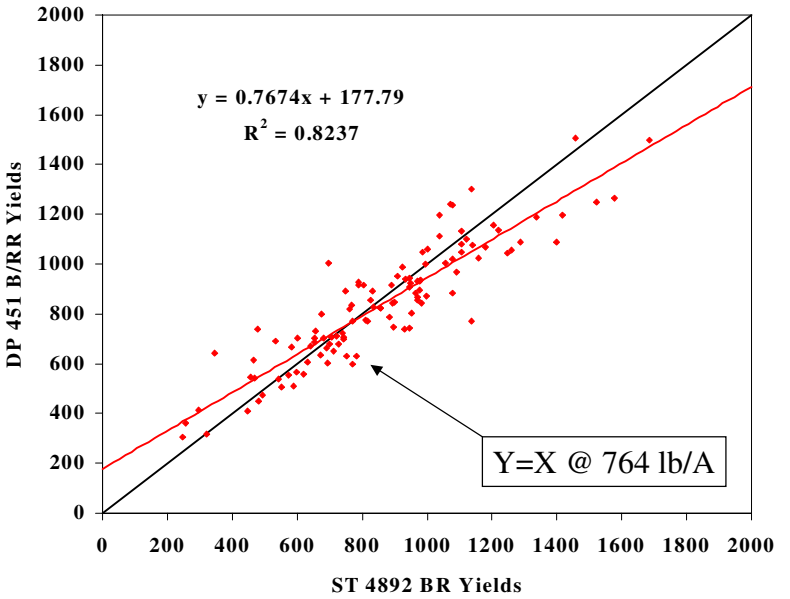

Figure 1. Head to Head Lint Yield Regression of DP 451 B/RR vs. ST 4892 BR using Mid-South Data only.

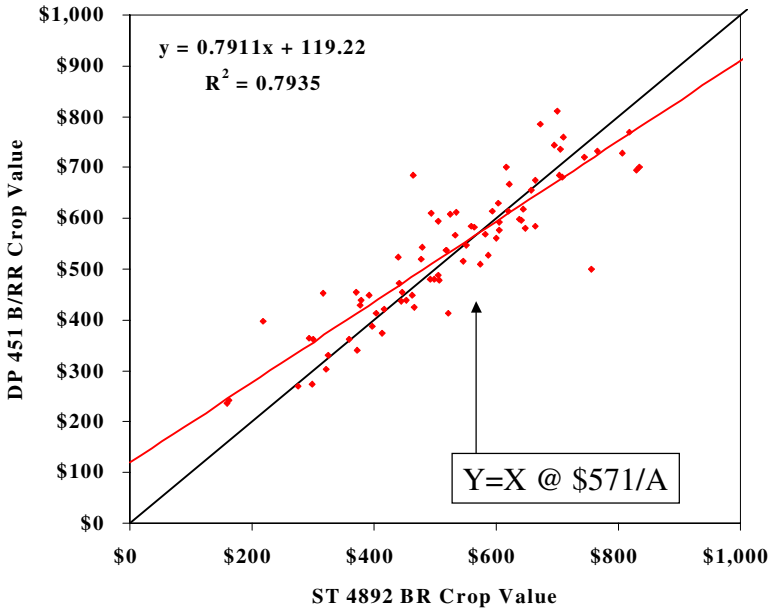

Figure 2. Head to Head Crop Value Regression of DP 451B/RR vs. ST. 4892 BR using Mid-South Data only.

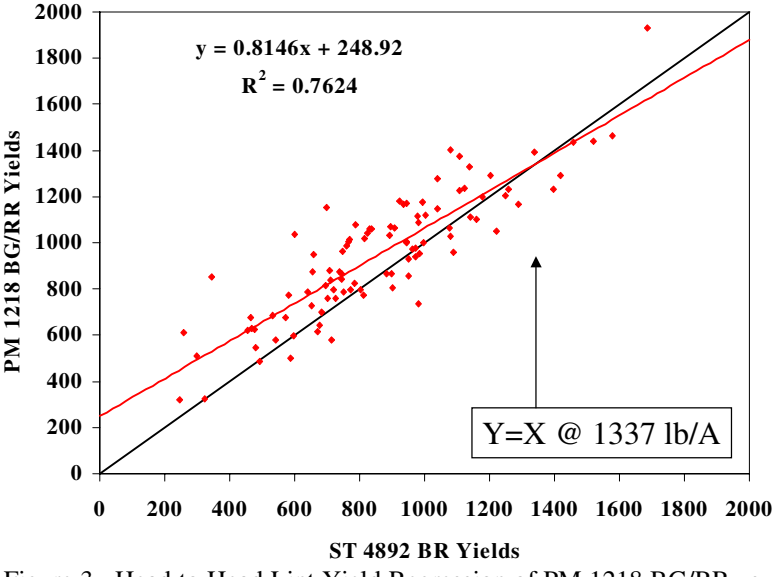

Figure 3. Head to Head Lint Yield Regression of PM 1218 BG/RR vs. ST 4892 using Mid-South Data only.

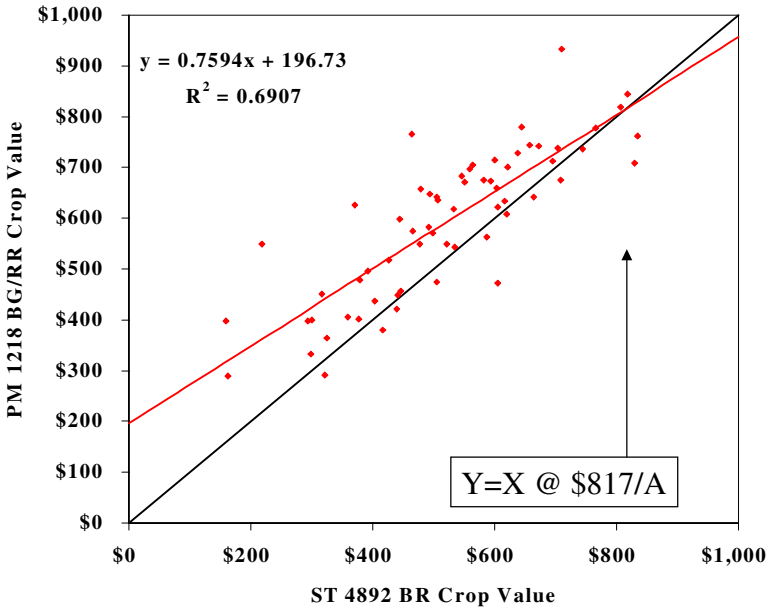

Figure 4. Head to Head Crop Value Regression Analysis on PM 1218 BG/RR vs. ST 4892 BR using Mid-South data only.

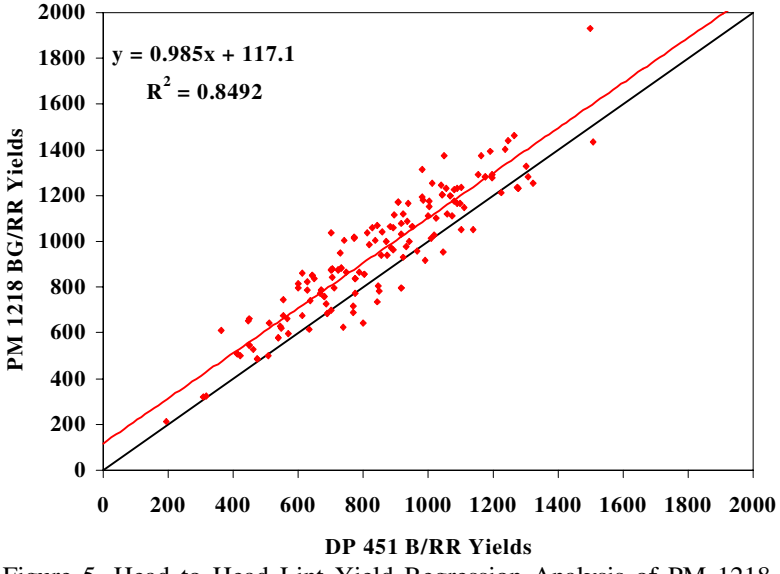

Figure 5. Head to Head Lint Yield Regression Analysis of PM 1218 BG/RR vs. DP 451 B/RR using Mid-South data only.

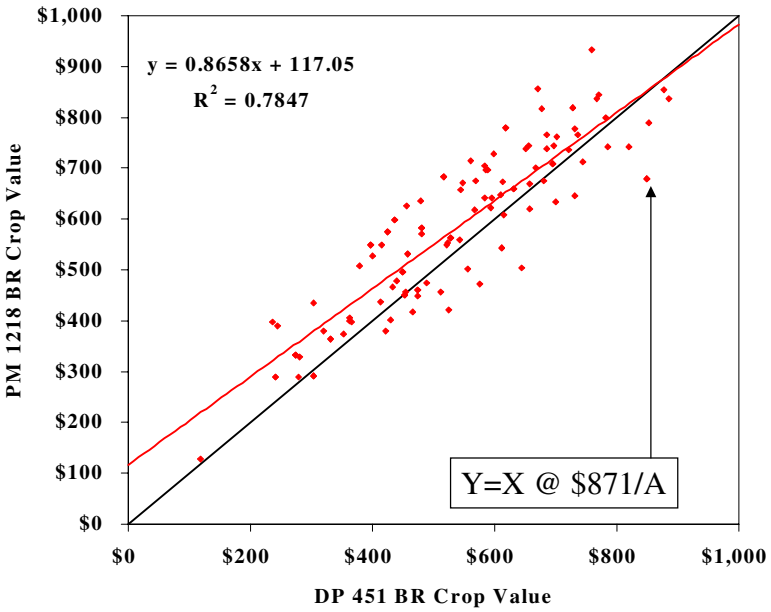

Figure 6. Head to Head Crop Value Regress Analysis on PM 1218 BG/RR vs. DP 451 B/RR using Mid-South data only.