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Association Studies in Certain Promising Aromatic Rice (*Oryza sativa* L.) Varieties on NEP Zone

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Abstract: Yield is a complex characteristic that depends on various attributes. Therefore, knowledge about the relationship of diverse traits to yield is crucial for making an efficient selection strategy. The grain yield/plant exhibited a highly significant and positive association with biological yield /plant followed by number of grain/panicle, number of productive tillers/plant, test weight, kernel length and L:B ratio in F1s at both phenotypic and genotypic levels. The highest positive direct effect on grain yield/ plant was exerted by biological yield/ plant and harvest-index in F1s at both phenotypic and genotypic levels. Therefore, these traits should be utilized in making a selection strategy for yield improvement in rice.

Index Terms *- Aromatic Rice (Oryza sativa L.), Correlation, Path, Yield*

I. INTRODUCTION

Rice (*Oryza sativa* L., 2n=24) is a self-pollinated plant that is a member of the grass family Gramineae (Poaceae). There are 25 recognized species within the class *Oryza*, of which 23 are wild and two are tame. *Oryza sativa* and *Oryza glaberrima* are the cultivars. While *Oryza sativa* is grown all over the world, *Oryza glaberrima* has only been domesticated for about 3500 years in West Africa. *Oryza sativa*, also known as Asian rice, or *Oryza glaberrima*, in some cases known as African rice, is a type of grass. Worldwide rice cultivars of *Oryza sativa* are typically divided into three subspecies: *Indica*, *Japonica*, and *Javanica*. The *Japonica* is grown in Japan, the *Indica* is grown in Indonesia, and the *Indica* is grown under Indian conditions. Rice, along with wheat and maize, makes up a significant staple food the world's population. Asia is the primary producer and consumer of more than 90% of the world's rice. Asia is alluded to as the "rice bowl" of the globe since it is domestic to two-thirds of the world's destitute and 60 percent of the world's population.

Rice is grown in more than a hundred countries with a total harvested area of approximately 166.47 million hectares, producing around 513.03 MMT annually. According to the World Agriculture Production, USDA, April 2022, China is the world's top producer of rice, producing 148.99 MMT in total, followed by India, which produced 129.00 MMT in total. In India, nearly every state grows rice. From the 141.00 million hectares of total cultivated land, it has been estimated that nearly 40.95 million hectares are used for rice farming, producing 127.93 MT on average per hectare (Ministry of Agriculture and Farmers' Welfare, 2021-22). In India's best states for rice production, Uttar Pradesh came in second. With a total area under rice cultivation of 6.02 million hectares and a production of 15.66 million tonnes, Uttar Pradesh accounts for 12.81% of India's total rice production. In Uttar Pradesh, there are roughly 2601 kg of production per acre.

Aromatic rice is very popular in Asia countries and recently has gained wide acceptance in the USA, Europe, China, and South Africa. Aromatic rice occupies a prime position in Indian culture not only because of its high quality but also because of its auspicious nature. The aroma in the rice is due to the presence of 2-acetyl-1-pyrroline. India has nearly 300 indigenous collections of aromatic rice varieties (Singh *et al*. 2016). These varieties fall under different types based on kernel length: small-grained (≤5.51 mm); medium-grained

(5.51–6.60 mm); long-grained (6.61–7.51 mm); and very long-grained (>7.51 mm). In general, there are two types of aromatic rice: basmati and non-basmati types. Basmati is a premium quality aromatic rice and it is mainly cultivated for export purposes. There is a huge demand for Basmati in the International market.

Correlation is a statistical measure that is used to find out the degree (strength) and direction of the relationship between two or more variables or characters. The coefficient of correlation expresses the association between two variables but tells us nothing about the causal relations of variables, i.e., which variable is dependent and which is independent. Therefore, the study of path coefficients is necessary. The concept of path analysis was created by Wright (1921), but the method was initially utilized for plant determination by Dewey and Lu (1959). The path coefficient is simply a standardized partial regression coefficient, which splits the correlation coefficient into the measures of direct and indirect effects. In other words, it measures the direct and indirect contribution of various independent characters on the dependent character like yield. It also estimates residual effects. Path analysis clearly indicates the relative importance of different yield components so that one may identify the most important yield components.

II. RESEARCH METHODOLOGY

This experiment was carried out at the Main Experimental Field of Veer Kunwar Singh College of Agriculture, Dumraon, Buxar Bihar India. The experimental material was based on a line x tester set of fifty hybrids (F1's) developed by crossing ten lines (females) with five testers (males). An attempt was made to make fifty cross-combinations during the Kharif season in 2022 to generate F1s. The fifty F1s along with parents and two checks, Rajendra Kasturi and Badshah Bhog were evaluated to work out the correlation and path coefficient of their various attributes on grain yield in Randomized Complete Block Design with three replications during kharif 2023. Estimation of correlation coefficients was done as per Searle, 1961 and path-coefficient analysis was done as per Dewey and Lu, 1959

III. RESULTS AND DISCUSSION

The estimates of simple correlation coefficients at phenotypic and genotypic levels computed between eighteen characters under study are displayed in Table 1. The phenotypic correlation coefficients and genotypic correlation coefficients for sixteen traits were analyzed in the F_1s, of fifty cross combinations and their fifteen parents. Differences in magnitude as well as in direction were observed for different traits. However, both the genotypic correlation coefficient and phenotypic correlation coefficient displayed comparable signs with few special cases. In general, both positive and negative character associations were observed among different traits. Further, it was also observed that the estimates of the genotypic correlation coefficient were higher than the corresponding phenotypic correlations.

The grain yield per plant exhibited a highly significant and positive correlation with biological yield/plant (0.951, 0.961), followed by harvest index (0.776, 0807), number of grains/panicle (0.722, 0.739), number of productive tillers/plant (0.682, 0.697), test weight (0.490, 502), kernel length (0.253, 0.262) in F_1s at phenotypic and genotypic level respectively. The grain yield/plant was found to be positively and significantly associated with L: B ratio (174, 0.164) F_1s genotypic and phenotypic levels, respectively. The above characters had a strong positive association with grain yield, which augurs well for providing correlated response during selection for improving these characters. The above observations of strong positive associations between yield and yield components are in agreement with the available literature on rice viz., Kumar *et al.*, 2018; Prakash *et al.*, 2018, Saleh *et al*. 2020 and Shrivastav *et al*. 2023).

Biological yield/plant showed a positive and highly significant correlation with grain yield/planet (0.951, 0.961), followed by the number of productive tillers/plant (0.701, 0.699), number of grains/panicle (0.647, 0.676), test weight (0.494, 0.516) and kernel length (0.290, 0.306), further; positive and significant correlation with L: B ratio (0.156, 0.173) in F_1s at phenotypic and genotypic level respectively. These findings are in accordance with the results of Saleh *et al*. 2020, Aparna *et al*. 2021, Singh *et al*. 2022, Ratnam *et al*. 2023, Thakur *et al*. 2023.

Days to 50% flowering showed positive and highly significant correlation with days to maturity (0.985), plant height (0.502), aroma (0.256) and disease severity (0.241) in F_1s. Days to maturity showed positive and highly significant correlation with plant height (0.544), aroma (0.283), disease severity (0.239) and panicle length (0.189) in F_1s, A Positive and significant association was recorded with the number of grains/panicle (0.161) in F_1s. Flag leaf area showed positive and highly significant correlation with

aroma (0.389), panicle length (0.303), plant height (0.295) and disease severity (0.204) in F_1s. The number of productive tillers/plant showed a positive and highly significant correlation with biological yield/plant (0.701), number of grains/panicle (0.326) and harvest index (0.497) in F_1s. Plant height showed a positive and highly significant correlation with aroma (0.536) and panicle length (0.326) in F_1s. Panicle length showed a positive correlation with aroma (0.321) in F_1s. Sritama *et al*. 2015, Kumar *et al*. 2018 and Saleh *et al.* 2020 found similar results. The number of grains/panicle showed a positive and highly significant correlation with biological yield/plant (0.647) and harvest index (0.617) in F_1s. Test weight showed positive and highly significant correlation with kernel length (0.623), biological yield/plant (0.494), harvest index (0.353), kernel breadth (0.323) and L: B ratio (0.255) in F_1s. Kernel length showed a positive and highly significant correlation with L: B ratio (0.693) and biological yield/plant (0.290) in F_1s. L:B ratio showed a positive and significant correlation with biological yield/plant (0.156) and harvest index (0.146) in F_1s. Disease severity showed a negative and significant correlation with biological yield/plant (-0.138) in F1s. The estimates of correlation coefficients obtained in the present study are broadly in conformity with previous reports in rice (Ahamed *et al.* 2014; Sakina *et al.* 2015; Kumar *et al.* 2018; Prakash *et al.* 2018, Saha *et al*. 2019, Saleh *et al*. 2020, Aparna *et al*. 2021, Ratnam *et al*. 2023, Thakur *et al*. 2023 and Shrivastav *et al*. 2023).

Path coefficient analysis is a tool to partition the observed correlation coefficient into direct and indirect effects of yield components on grain yield. Path analysis provides a more accurate picture of character associations for formulating an efficient selection strategy. Path coefficient analysis differs from simple correlation in that it points out the causes and their relative importance, whereas the later measures simply the mutual association, ignoring the causation. The concept of path coefficient was developed by Wright S. (1921) and the technique was first used for plant selection by Dewey and Lu (1959). Path analysis has emerged as a powerful and widely used technique for understanding the direct and indirect contributions of diverse characters to economic yield in crop plants so that the relative importance of various yield-contributing characters can be evaluated. The direct and indirect effects of fifteen characters on grain yield per plant estimated by path coefficient analysis using phenotypic and genotypic correlations, are given in **Table 2,** respectively.

The highest positive direct effect on grain yield per plant was exerted by biological yield per plant (0.0.680), followed by harvest index (0.292), number of grains/panicle (0.0.97) and days to maturity (0.0.82) in F_1s. The direct effects of the remaining characters were too low to be considered important in F_1s and F_2s, respectively. Thus, biological yield per plant and harvest-index emerged as the most important direct yield components on which emphasis should be given during simultaneous selection aimed at improving grain yield in rice. These characters have also been identified as major direct contributors to grain yield by Kishore *et al.* (2007), Ahmad *et al.* (2014), Prakash *et al.* (2018), Kumar *et al.* (2018), and Shreshtha *et al.* (2023).

Table 1 – Estimates of genotypic and phenotypic correlation coefficients (F_1s) between 16 characters in aromatic rice

Characters		Days to 50% flowering	Days to maturity	Flag leaf area (cm2)	Productive Tillers /plant	Plant height (cm)	Panicle length (cm)	No of grains/panicle	Test weight (g)	Kernel length (mm)	Kernel breadth (mm)	L:B ratio	Aroma	Disease severity	Biological yield /plant (g)	Harvest index (%)	Grain yield/ plant (g)
Days to 50% flowering	G	1.000	0.988**	0.066	-0.314**	0.509**	0.190**	0.157*	-0.172*	-0.352**	-0.059	-0.244**	0.258**	0.252**	-0.142*	0.000	-0.092
	P	1.000	0.985**	0.061	-0.275**	0.502**	0.172*	0.155*	-0.171*	-0.350**	-0.058	-0.241**	0.256**	0.241**	-0.137	0.001	-0.090
Days to maturity	G			0.043	-0.328**	0.550**	0.210**	0.165*	-0.209**	-0.355**	-0.042	-0.257**	0.285**	0.251**	-0.154*	-0.029	-0.109
	P			0.039	-0.291**	0.544**	0.189**	0.161*	-0.207**	-0.353**	-0.041	-0.254**	0.283**	0.239**	-0.151*	-0.028	-0.109
Flag leaf area (cm2)	G				-0.251**	0.305**	0.359**	-0.308**	0.034	-0.094	-0.106	-0.003	0.409**	0.227**	-0.286**	-0.127	-0.269**
	P				-0.212**	0.295**	0.303**	-0.296**	0.029	-0.084	-0.100	0.001	0.389**	0.205**	-0.263**	-0.123	-0.252**
No. Productive Tillers /plant	G					-0.463**	-0.228**	0.381**	0.162*	0.061	0.036	-0.006	-0.227**	-0.055	0.699**	0.557**	0.697**
	P					-0.414**	-0.164*	0.326**	0.142*	0.049	0.037	-0.012	-0.206**	-0.023	0.701**	0.497**	0.682**
Plant height (cm)	G						0.534**	-0.091	-0.458**	-0.423**	-0.089	-0.287**	0.542**	0.141*	-0.423**	-0.400**	-0.455**
	P						0.466**	-0.086	-0.450**	-0.417**	-0.086	-0.283**	0.536**	0.131	-0.403**	-0.386**	-0.442**
Panicle length (cm)	G							0.064	-0.324**	-0.453**	-0.143*	-0.284**	0.372**	-0.168*	-0.219**	-0.110	-0.193**
	P							0.068	-0.277**	-0.402**	-0.127	-0.248**	0.321**	-0.135	-0.175*	-0.091	-0.155*
No of grains/panicle	G								-0.092	-0.059	-0.244**	0.119	-0.082	-0.166*	0.676**	0.635**	0.739**
	P								-0.092	-0.059	-0.240**	0.116	-0.083	-0.161*	0.647**	0.617**	0.722**
Test weight (g)	G									0.630**	0.327**	0.261**	0.014	-0.013	0.516**	0.365**	0.502**
	P									0.623**	0.323**	0.255**	0.015	-0.011	0.494**	0.353**	0.490**
Kernel length (mm)	G										0.152*	0.696**	-0.079	-0.109	0.306**	0.164*	0.262**
	P										0.150*	0.693**	-0.077	-0.104	0.290**	0.157*	0.253**
Kernel breadth (mm)	G											-0.594**	0.024	0.047	0.078	-0.055	0.022
	P											-0.598**	0.022	0.034	0.082	-0.061	0.026
L: B ratio	G												-0.080	-0.114	0.173*	0.145*	0.174*
	P												-0.076	-0.101	0.156*	0.146*	0.164*
Aroma	G													0.072	-0.115	-0.107	-0.137
	P													0.071	-0.113	-0.102	-0.135
Disease severity	G														-0.157*	0.002	-0.111
	P														-0.138*	0.010	-0.095
Biological yield /plant (g)	G															0.625**	0.961**
	P															0.568**	0.951**
Harvest index (%)	G																0.807**
	P																0.776**
Grain yield/plant (g)	G																1.000
	P																1.000

Table – 2 Estimates of genotypic and phenotypic direct and indirect (F_1s) effect of 16 characters on grain yield/ plant in aromatic rice

Characters		Days to 50% flowering	Days to maturity	Flag leaf area (cm2)	Productive Tillers /plant	Plant height (cm)	Panicle length (cm)	No of grains/panicle	Test weight (g)	Kernel length (mm)	Kernel breadth (mm)	L: B ratio	Aroma	Disease severity	Biological yield /plant (g)	Harvest index (%)	Grain yield/ plant (g)
Days to 50% flowering	G	**-0.122**	0.124	0.000	-0.010	-0.013	0.002	0.021	-0.020	0.011	0.002	0.004	-0.004	0.004	-0.089	0.000	-0.092
	P	**-0.079**	0.080	0.000	-0.002	-0.013	0.001	0.015	-0.014	0.006	0.002	0.007	-0.003	0.004	-0.093	0.000	-0.090
Days to maturity	G	-0.121	**0.125**	0.000	-0.010	-0.014	0.002	0.022	-0.025	0.011	0.001	0.005	-0.004	0.004	-0.096	-0.008	-0.109
	P	-0.078	**0.082**	0.000	-0.002	-0.015	0.001	0.016	-0.017	0.006	0.001	0.007	-0.004	0.004	-0.103	-0.008	-0.109
Flag leaf area (cm2)	G	-0.008	0.005	**-0.007**	-0.008	-0.008	0.003	-0.041	0.004	0.003	0.003	0.000	-0.006	0.004	-0.179	-0.034	-0.269**
	P	-0.005	0.003	**-0.004**	-0.002	-0.008	0.002	-0.029	0.002	0.001	0.003	0.000	-0.005	0.003	-0.179	-0.036	-0.252**
No. Productive Tillers /plant	G	0.038	-0.041	0.002	**0.031**	0.012	-0.002	0.051	0.019	-0.002	-0.001	0.000	0.003	-0.001	0.438	0.149	0.697**
	P	0.022	-0.024	0.001	**0.008**	0.011	-0.001	0.032	0.012	-0.001	-0.001	0.000	0.003	0.000	0.476	0.145	0.682**
Plant height (cm)	G	-0.062	0.069	-0.002	-0.014	**-0.026**	0.004	-0.012	-0.055	0.013	0.003	0.005	-0.008	0.002	-0.265	-0.107	-0.455**
	P	-0.040	0.044	-0.001	-0.003	**-0.027**	0.004	-0.008	-0.037	0.007	0.003	0.008	-0.007	0.002	-0.274	-0.113	-0.442**
Panicle length (cm)	G	-0.023	0.026	-0.002	-0.007	-0.014	**0.008**	0.008	-0.039	0.014	0.004	0.005	-0.005	-0.003	-0.137	-0.029	-0.193**
	P	-0.014	0.015	-0.001	-0.001	-0.012	**0.008**	0.007	-0.023	0.007	0.004	0.007	-0.004	-0.002	-0.119	-0.027	-0.155*
No of grains / panicle	G	-0.019	0.021	0.002	0.012	0.002	0.001	**0.133**	-0.011	0.002	0.007	-0.002	0.001	-0.003	0.423	0.170	0.739**
	P	-0.012	0.013	0.001	0.003	0.002	0.001	**0.097**	-0.007	0.001	0.008	-0.003	0.001	-0.002	0.440	0.180	0.722**
Test weight (g)	G	0.021	-0.026	0.000	0.005	0.012	-0.003	-0.012	**0.119**	-0.020	-0.009	-0.005	0.000	0.000	0.323	0.098	0.502**
	P	0.014	-0.017	0.000	0.001	0.012	-0.002	-0.009	**0.081**	-0.011	-0.010	-0.007	0.000	0.000	0.336	0.103	0.490**
Kernel length (mm)	G	0.043	-0.044	0.001	0.002	0.011	-0.004	-0.008	0.075	**-0.032**	-0.004	-0.012	0.001	-0.002	0.192	0.044	0.262**
	P	0.028	-0.029	0.000	0.000	0.011	-0.003	-0.006	0.051	**-0.017**	-0.005	-0.019	0.001	-0.002	0.197	0.046	0.253**
Kernel breadth (mm)	G	0.007	-0.005	0.001	0.001	0.002	-0.001	-0.033	0.039	-0.005	**-0.029**	0.010	0.000	0.001	0.049	-0.015	0.022
	P	0.005	-0.003	0.000	0.000	0.002	-0.001	-0.023	0.026	-0.003	**-0.032**	0.017	0.000	0.001	0.055	-0.018	0.026
L:B ratio	G	0.030	-0.032	0.000	0.000	0.008	-0.002	0.016	0.031	-0.022	0.017	**-0.018**	0.001	-0.002	0.109	0.039	0.174*
	P	0.019	-0.021	0.000	0.000	0.008	-0.002	0.011	0.021	-0.012	0.019	**-0.028**	0.001	-0.001	0.106	0.043	0.164*
Aroma	G	-0.032	0.036	-0.003	-0.007	-0.014	0.003	-0.011	0.002	0.003	-0.001	0.001	**-0.014**	0.001	-0.072	-0.029	-0.137
	P	-0.020	0.023	-0.002	-0.002	-0.014	0.002	-0.008	0.001	0.001	-0.001	0.002	**-0.013**	0.001	-0.077	-0.030	-0.135
Disease severity	G	-0.031	0.031	-0.002	-0.002	-0.004	-0.001	-0.022	-0.002	0.003	-0.001	0.002	-0.001	**0.015**	-0.098	0.001	-0.111
	P	-0.019	0.020	-0.001	0.000	-0.004	-0.001	-0.016	-0.001	0.002	-0.001	0.003	-0.001	**0.015**	-0.094	0.003	-0.095
Biological yield /plant (g)	G	0.017	-0.019	0.002	0.022	0.011	-0.002	0.090	0.061	-0.010	-0.002	-0.003	0.002	-0.002	**0.626**	0.167	0.961**
	P	0.011	-0.012	0.001	0.006	0.011	-0.001	0.063	0.040	-0.005	-0.003	-0.004	0.002	-0.002	**0.680**	0.166	0.951**
Harvest index (%)	G	0.000	-0.004	0.001	0.017	0.011	-0.001	0.085	0.043	-0.005	0.002	-0.003	0.002	0.000	0.392	**0.268**	0.807**
	P	0.000	-0.002	0.001	0.004	0.010	-0.001	0.060	0.029	-0.003	0.002	-0.004	0.001	0.000	0.386	**0.292**	0.776**

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References:

Ahamed, A.; Sharma, V.; Paswan, S.K.; Singh, V.K. and Verma, O.P. (2014). Correlation and Path Coefficient Analysis of Economically Important Traits in Rice (*Oryza sativa* L.) Germplasm under Sodic Soil, *Res. J. Agri. Sci.*, **5**(4): 806-809.

Anonymous, (2022). United States department of agriculture and foreign agricultural services. Anonymous, 3rd Advance Estimates, (2020-21). Crops Division, Department of Agriculture, Circular series world agricultural production.

Anonymous (2021-22). Directorate of economics and statistics, dept. of agriculture and co-operation. Ministry of Agriculture, Government of India.

Aparna and Deo. I., (2021). Correlation and path coefficient analysis for yield and its related traits in rice (Oryza sativa L.)., *International Journal of Chemical Studies;* 9(1): 1757-1760.

Dewey DR and Lu KH. 1959. Correlation and path coefficient analysis for components of crested wheat grass seed production. Agronomy Journal, 51: 515-518.

Kumar, S.; Chauhan, M.P.; Tomar, A.; Kasana, R.K. and Kumar, N. (2018). Correlation and path coefficient analysis in rice (*Oryza sativa* L.), *The Pharma Innovation J.*, **7**(6): 20-26.

Kishore NS, Ansari NA, Babu VR, Rani NS and Rao LV. 2007. Correlation and path analysis in aromatic and non-aromatic rice genotypes. *Agricultural Science Digest*, 27: 122-124.

Prakash, H.P.; Verma, O.P.; Chaudhary, A.K. and Amir, M. (2018). Correlation and Path Coefficient Analysis in Rice (*Oryza sativa* L.) for Sodicity Tolerance, *Int. J. Curr. Microbiol. App. Sci.*, **7**(07): 177-187.

Ratnam T.V.; Ravi Kumar B.N.V.S.R.; Rao L.B.S.; Shrinivas T. and Anand Kumar A.D.V.S.L.P. (2023). Assessment of Genetic Variability, Character Association and Path Analysis for Yield and Quality Traits in Zinc and Iron Rich Landraces of Rice. *Agricultural Science Digest.* **D-5678: 1-6.**

Saha, S.R., Hassan, L., Haque, M.A., Islam, M.M. and Rasel, M. (2019). Genetic variability, heritability, correlation and path analyses of yield components in traditional rice (*Oryza sativa* L.) landraces. *Journal of Bangladesh Agricultural University*, 17(1): 26–32.

Singh P. (2016). Marker-assisted selection for improvement of aromatic rice (*Oryza sativa* L.) against bacterial leaf blight (*Xanthomonas oryzae* pv. *oryzae*). Ph.D dissertation of Banaras Hindu University, BHU, Varanasi, pp. 172.

Searle SR. 1961. Phenotypic, genotypic and environmental correlations. Biometrics, 17: 474-480.

Sakina, A.; Ahmed, I.; Shahzad, A.; Iqbal, M. and Asif, M. (2015). Genetic variation for salinity tolerance in Pakistani rice (*Oryza sativa* L.) germplasm. *J. Agro Crop Sci*., 0931-2250.

Shrivastav, S.P. and Verma O.P. (2023). Correlation and Path Coefficients Analysis for Yield and its Contributing Traits in Rice (*Oryza sativa* L.) under sodic soil. *Journal of Rice Research* 2023, Vol 16, No.1 **32-40.**

Shrestha, S.; Timilsina R.H. and Pandey, K. (2023). Assessment of genetic variability, heritability and correlation in spring rice genotypes (*Oryza sativa* L.) At Ratnanagar, Chitwan in

Thakur, K.; Sharma, M.K.; Banu, S.; Saharia, D.D.; Borogohain, I. and Deka S.D. (2023). Genetic variation and character association for grain yield and component traits in traditional rice (***Oryza sativa*** L.) cultivars of Assam. *Electronic J. of Plant Breeding.*14 (1): 349-353.

Wright S. 1921. Correlation and causation. *Journal of Agric. Research*, 203: 557-585.