ACTA Acta Sci. Pol., Agricultura 11(2) 2012, 53-61

EVALUATION OF YIELD DETERMINATION OF SPRING WHEAT GROWN IN MONOCULTURE INTERRUPTED WITH STUBBLE CROP GROWTH BY MEANS OF PATH ANALYSIS

Katarzyna Rymuza, Elżbieta Turska, Grażyna Wielogórska, Małgorzata Wyrzykowska, Antoni Bombik
Siedlce University of Natural Sciences and Humanities

Abstract. Studies were conducted in years 2001-2004 at the Agricultural Experimental Station in Zawady, which is part of the Siedlce University of Natural Sciences and Humanities. The objective of the work was to analyse the effect of some characteristics of spring wheat grown in monoculture on its yield, interrupted with stubble crop growth. The effect of yield components on spring wheat yield was evaluated using the method of path analysis. It was found that, in monoculture, the yield of spring wheat grown after mustard was determined mainly by spike length, number of spikelets in the spike, mass of 1000 grains, and spike density per 1 m^2. The yield of spring wheat grown after phacelia was the most strongly determined by the mass of 1000 grains, number of grains per spike, and spike density per 1 m^2.

Key words: direct effects of causative variables, indirect effects of causative variables, stubble crop, yield elements, yield-forming characteristics

INTRODUCTION

Increasing share of cereals in the sowing structure causes the plants to be frequently grown in monoculture, which has a negative effect on both the soil and plant yield [Deryło 1990]. Effects of monoculture may partly be minimalised through the introduction of stubble crops, which positively affect the plot by regenerating it [Deryło 1990, Lepiarczyk 1999, Turska *et al*. 2010]. It results from the studies by Dzienia and Boligłowa [1993] and by Garwood *et al*. [1999] that stubble crop left in the form of mulch keeps soil humidity at a higher level and counteracts erosion.

Spring wheat yield is formed by many characteristics, which are yield components and other yield-forming morphological characteristics [Gozdowski and Mądry 2008].

Corresponding author – Adres do korespondencji: dr inż. Katarzyna Rymuza, Department of Experimenting, Plant Breeding and Seed Production of Siedlce University of Natural Sciences and Humanities, Prusa 14, 08-110 Siedlce, e-mail: krymuza@op.pl

The following are classified as yield components: number of spikes per area, average number of caryopses per spike, and average mass of a single caryopsis [Dofing and Knight 1992, Zając *et al*. 1997, Garcia del Moral *et al*. 2005]. Other yield-forming characteristics are plant morphological traits and traits that characterize plant lowland meadow as a whole, namely the number of all shoots per area, number of spikelets per spike, and the number of caryopses per spike [Samonte *et al*. 1998, Gozdowski and Mądry 2008, Gozdowski *et al*. 2008b].

For the analysis of the effect of yield-forming characteristics on plant yield, different statistical methods are applied, among which the leading place is occupied by path analysis [Gołaszewski 1996, Rozbicki 1997, Mohammad *et al*. 2003, Gozdowski *et al*. 2008a, Weber 2008]. Path analysis allows multidimensional evaluation of the effects of many characteristics (independent variables) on the yield (dependent variable). Effect of each characteristic may be divided into direct and indirect effects via other characteristics. The method was introduced by Wright in 1921 and nowadays is often used for the evaluation of different cause and effect relations between the variables of the studied phenomena [Gozdowski and Mądry 2008].

The aim of the work was the analysis of the effect of the characteristics on spring wheat yield, grown in monoculture, in the conditions of different forecrop introduction. Study hypothesis assumed that the yield of spring wheat grown in monoculture after white mustard is formed by other characteristics than the yield of spring wheat grown after tansy phacelia. Analysis was based on the method of Wright's path analysis, in order to assess its usefulness for the evaluation of the effect of the studied characteristics on yield variability.

MATERIAL AND METHODS

Study material was made of the results of experiments conducted in years 2001--2004 at the Agricultural Experimental Station in Zawady (52°06' N; 22°56' E), which is part of the Siedlce University of Natural Sciences and Humanities. Three-factor experiment was set in a split-plot design in four repetitions on brown soil classified as one of autogenic soils, formed from loamy sand, very good rye complex, class IIIb.

Spring wheat cultivar Opatka was sown on the experimental plots of 20 m^2 in the first or second decade of April in the number of 450 grains per m^2.

The studied factors were: soil cultivation technique (A_1 – wheat direct sowing, A_2 – traditional growth), soil cultivation technique for stubble crop (B_1 – intercrop direct sowing, later left in the form of mulch, B_2 – set of post-harvest operations and intercrop sowing, which was later ploughed to the depth of 25 cm), and a plant grown in stubble crop (C_1 – white mustard, C_2 – tansy phacelia).

Stubble crops, according to the pattern of the experiment, were left for winter in the form of mulch or ploughed. In the spring, homogenous mineral fertilization was applied: 90 $kg \cdot ha^{-1}$ N (60% of the dose pre-sowing and 40% at the straw shooting phase), 39 $kg \cdot ha^{-1}$ P, and 90 $kg \cdot ha^{-1}$ K.

Thermal and humidity conditions during the experiment are presented in Table 1. Air temperature and precipitation during spring wheat growth in the research years were diversified. Precipitation amount and distribution and average air temperature in 2004 were the closest to the many-years' average. In 2005, excessive precipitation in comparison with the many-years' average occurred in May and July, and shortage in

April, June, and August. Year 2006 was characterized by high temperatures and low precipitation from April to July.

Table 1. Thermal and humidity conditions during spring wheat growth
Tabela 1. Warunki termiczno-wilgotnościowe panujące w okresie wegetacji pszenicy jarej

Month Miesiąc	Precipitation sum – Suma opadów, mm				Mean temperature – Średnia temperatura, ºC			
	2004	2005	2006	multiyear wielolecie	2004	2005	2006	multiyear wielolecie
April Kwiecień	35.9	12.3	29.8	29.4	8.0	8.6	8.4	7.2
May Maj	97.0	64.7	39.6	54.3	11.6	13.0	13.6	13.2
June Czerwiec	52.8	44.1	24.0	69.3	15.4	15.9	17.2	16.2
July Lipiec	49.0	86.5	16.2	70.6	17.5	20.2	22.3	17.6
August Sierpień	66.7	45.4	227.6	59.8	18.9	17.5	18.0	16.9

The studied characteristics were: grain yield (Y), spike length (X_1), number of spikelets per spike (X_2), mass of 1000 grains (X_3), straw length (X_4), number of grains per spike (X_5), and spike density per 1 m^2 (X_6). According to the methodology given by Gozdowski and Mądry [2008], spike density and grain number were counted as yield components, whereas the other characteristics were classified as morphological yield-forming characteristics.

For the statistical analysis, three-year-long results were used, which were obtained on the plots on which different stubble crops were applied (regardless of their cultivation method). For studying the relations between the characteristics and the yield, linear correlation coefficient and Wright's path analysis were used. Path analysis was carried out on the basis of multiple regression model on standardized variables. Partial multiple regression coefficients for standardized variables are path coefficients, which express the direct effect of the particular variables on grain yield. Indirect effects of the influence of the characteristics on the yield are the sum of correlation coefficient products between pairs of characteristics and the proper value of path coefficient [Gozdowski and Mądry 2008]

All the calculations were carried out in the program Statistica 6.0 and in the spreadsheet application EXCEL.

RESULTS

Spring wheat yield grown in monoculture in the conditions of forecrop application in the form of white mustard depended significantly on spike length (r = 0.614) and the number of grains per spike (r = 0.429), as well as spike density (r = 0.433). Moreover, positive correlation was shown between the mass of 1000 grains and the following characteristics: spike length (r = 0.388), grain number (r = 0.412), spike density (r = 0.415), and straw length (r = 0.306). Spike length and density were also significantly, positively correlated (r = 0.433), (Table 2).

Table 2. Correlation coefficient matrix between the characteristics of spring wheat grown after white mustard
Tabela 2. Macierz współczynników korelacji pomiędzy cechami pszenicy jarej uprawianej po gorczycy białej

Variable (charactersitic) Zmienna (cecha)	Y	X_1	X_2	X_3	X_4	X_5	X_6
Yield (Y) Plon (Y)	1.000						
Spike length (X_1) Długość kłosa (X_1)	0.641*	1.000					
Spikelet number (X_2) Liczba kłosków (X_2)	0.225	0.047	1.000				
Mass of 1000 grains (X_3) Masa tysiąca ziaren (X_3)	0.426*	0.388*	0.242	1.000			
Straw length (X_4) Długość źdźbła (X_4)	0.086	0.218	0.259	0.306*	1.000		
Grain number (X_5) Liczba ziaren (X_5)	0.429*	0.480*	0.405*	0.412*	0.098	1.000	
Spike density (X_6) Obsada kłosów (X_6)	0.433*	0.433*	0.124	0.415*	0.196	0.257	1.000

* significant at $P \leq 0.05$ – istotne przy $P \leq 0,05$

The conducted path analysis showed 51% grain yield determination (white mustard forecrop) by its components and morphological yield-forming characteristics. Among direct influences, the highest and significant value (0.544) was demonstrated by spike length. The remaining characteristics affected to a small degree yield variability, which proves their correlation. Most indirect effects were positive, which demonstrates mutual, positive effect of the characteristics. Increasing the value of one yield-forming characteristic caused an increase in the values of the remaining characteristics. This effect was, however, relatively weak. Spike density, as yield component, had the greatest positive indirect effect (0.294). The effect resulted first of all from the indirect effect via spike length (0.236). Among the yield-forming morphological characteristics, the greatest indirect effect on grain yield was exerted via the mass of 1000 grains (0.265) and straw length (0.232). The effect of those characteristics resulted mostly from their indirect effect via spike length and was, respectively, 0.211 and 0.118. Similar indirect effect on the yield was also exerted via straw length. Sum of the effects of this characteristic amounted to 0.232 and resulted mainly from the indirect effect via spike length (Table 3).

In the case of wheat growth after tansy phacelia, significant correlation of yield components was found (of the number of grains per spike and spike density) with yield-forming characteristics (spike length and mass of 1000 grains). Significant, positive correlation was observed also among the mass of 1000 grains and spike density. Significantly, positively related to one another were also straw length and spike density (Table 4). Positive relations indicate that, with the increase of one characteristics, values of the other characteristics also increase.

Table 3. Direct and indirect effects and correlation coefficients between the particular yield-forming characteristics and the yield of wheat grown after white mustard
Tabela 3. Efekty bezpośrednie i pośrednie oraz współczynniki korelacji między poszczególnymi cechami plonotwórczymi a plonem ziarna pszenicy uprawianej po gorczycy białej

Causative variable – Zmienna przyczynowa	Direct effect Efekt bezpośredni	Indirect effect Efekt pośredni	Correlation coefficient Współczynnik korelacji
Spike length (X_1) – Długość kłosa (X_1)	0.544*	0.097	0.641*
Indirect effect via X_2[1)] – Wpływ pośredni przez X_2[1)]		0.009	
Indirect effect via X_3 – Wpływ pośredni przez X_3		0.062	
Indirect effect via X_4 – Wpływ pośredni przez X_4		-0.034	
Indirect effect via X_6 – Wpływ pośredni przez X_6		0.060	
Number of spikelets (X_2) – Liczba kłosków (X_2)	0.184	0.199	0.225
Indirect effect via X_1 – Wpływ pośredni przez X_1		0.026	
Indirect effect via X_3 – Wpływ pośredni przez X_3		0.039	
Indirect effect via X_4 – Wpływ pośredni przez X_4		-0.041	
Indirect effect via X_6 – Wpływ pośredni przez X_6		0.017	
Mass of 1000 grains (X_3) – Masa tysiąca ziaren (X_3)	0.160	0.265	0.426*
Indirect effect via X_1 – Wpływ pośredni przez X_1		0.211	
Indirect effect via X_2 – Wpływ pośredni przez X_2		0.045	
Indirect effect via X_4 – Wpływ pośredni przez X_4		-0.048	
Indirect effect via X_6 – Wpływ pośredni przez X_6		0.057	
Straw length (X_4) – Długość źdźbła (X_4)	-0.157	0.232	0.086
Indirect effect via X_1 – Wpływ pośredni przez X_1		0.118	
Indirect effect via X_2 – Wpływ pośredni przez X_2		0.048	
Indirect effect via X_3 – Wpływ pośredni przez X_3		0.049	
Indirect effect via X_6 – Wpływ pośredni przez X_6		0.027	
Spike density per $1m^2$ (X_6) – Obsada kłosów (X_6)	0.138	0.294	0.433*
Indirect effect via X_1 – Wpływ pośredni przez X_1		0.236	
Indirect effect via X_2 – Wpływ pośredni przez X_2		0.023	
Indirect effect via X_3 – Wpływ pośredni przez X_3		0.066	
Indirect effect via X_4 – Wpływ pośredni przez X_4		-0.031	

* significant at $P \leq 0.05$ – istotne przy $P \leq 0,05$
[1)] symbols like in Table 2 – oznaczenia jak w tabeli 2

Path analysis showed 65% determination of spring what yield (tansy phacelia forecrop) by yield-forming characteristics: spike density, number of grains, and mass of 1000 grains. Values of the direct effects show that these characteristics affected yield variability positively and significantly, and the greatest effect was exerted by spike density (0.414). Number of grains and mass of 1000 grains to a similar extent determined wheat yield, and direct effects of this influence amounted to, respectively, 0.358 and 0.356. Indirect effects assumed positive values, which indicates that the increase in the values of one characteristics cause the increase in the values of the two remaining characteristics. Among yield components, lower indirect effects were found for the number of grains (0.113) than for spike density (0.191). In the case of spike density, the effect resulted first of all from the indirect effect via the mass of 1000 grains. The highest indirect effects were shown via the mass of 1000 grains and they resulted mainly from the positive effect via spike density (Table 5).

Table 4. Correlation coefficient matrix between the characteristics of spring wheat grown after tansy phacelia
Tabela 4. Macierz współczynników korelacji pomiędzy cechami pszenicy jarej uprawianej po facelii błękitnej

Variable (characteristic) Zmienna (cecha)	Y	X_1	X_2	X_3	X_4	X_5	X_6
Yield (Y) Plon (Y)	1.000						
Spike length (X_1) Długość kłosa (X_1)	0.304*	1.000					
Spikelet number (X_2) Liczba kłosków (X_2)	0.202	-0.017	1.000				
Mass of 1000 grains (X_3) Masa tysiąca ziaren (X_3)	0.582*	0.356*	0.127	1.000			
Straw length (X_4) Długość źdźbła (X_4)	0.251	0.240	0.325*	0.409*	1.000		
Grain number (X_5) Liczba ziaren (X_5)	0.532*	0.168	0.255	0.250	-0.091	1.000	
Spike density (X_6) Obsada kłosów (X_6)	0.605*	0.171	0.214	0.329*	0.408*	0.206	1.000

* significant at $P \leq 0.05$ – istotne przy $P \leq 0,05$

Table 5. Direct and indirect effects and correlation coefficients between the particular yield-forming characteristics and the yield of wheat grown after tansy phacelia
Tabela 5. Efekty bezpośrednie i pośrednie oraz współczynniki korelacji między poszczególnymi cechami plonotwórczymi a plonem ziarna pszenicy uprawianej po facelii błękitnej

Causative variable – Zmienna przyczynowa	Direct effect Efekt bezpośredni	Indirect effect Efekt pośredni	Correlation coefficient Współczynnik korelacji
Mass of 1000 grains – Masa tysiąca ziaren (X_3)	0.356*	0.225	0.582*
Indirect effect via X_5[1)] – Wpływ pośredni przez X_5[1)]		0.089	
Indirect effect via X_6 – Wpływ pośredni przez X_6		0.136	
Number of grains – Liczba ziaren (X_5)	0.358*	0.173	0.532*
Indirect effect via X_3 – Wpływ pośredni przez X_3		0.088	
Indirect effect via X_6 – Wpływ pośredni przez X_6		0.085	
Spike density – Obsada kłosów (X_6)	0.414*	0.191	0.605*
Indirect effect via X_3 – Wpływ pośredni przez X_3		0.117	
Indirect effect via X_5 – Wpływ pośredni przez X_4		0.074	

* significant at $P \leq 0.05$ – istotne przy $P \leq 0,05$
[1)] symbols like in Table 4 – oznaczenia jak w tabeli 4

DISCUSSION

So far, in literature there is a lack of works on the evaluation of the effect of characteristics on spring what yield with the use of path analysis. Few studies that used the method relate to winter wheat [Samborski *et al*. 2005, Weber 2008] or spring barley [Gozdowski *et al*. 2008a].

Analysis of correlation coefficients demonstrates that wheat yield, regardless of the applied forecrop, depends on the mass of 1000 grains, grain number, spike length, and spike density. Similar results were obtained by Sabo *et al*. [2002] and Samborski *et al*. [2005], who found that the number and mass of grains from the spike and favourable environmental conditions are the basis for obtaining high yield not only of wheat, but also of other cereals. Podolska *et al*. [2002] also prove that cereal yield size depends first of all on spike density, number of grains per spike, and mass of 1000 grains. Lack of significant effect of the number of grains in the spike on cereal yield was proven by Brzozowska *et al*. [2008]. Kuś and Jończyk [1997], however, claim that unambiguous determination of the effect of yield structure elements on yield size is difficult, since yield to a high extent depends on the cultivar and environmental conditions.

More precise yield determination analysis, with the use of path analysis, made it possible to point out which spring wheat characteristics affect directly or indirectly yield variability. Spike length has the greatest direct effect on the yield variability of spring wheat grown after white mustard. The remaining characteristics which were included in the analyzed path, namely the number of spikelets per spike, straw length, mass of 1000 grains, and spike density had little direct effect. Those characteristics, on the other hand, to a greater extent affected indirectly the yield. Significantly higher indirect effect of those characteristics resulted from mutual relations among them.

Yield of wheat grown after tansy phacelia to a large extent directly depended on the mass of 1000 grains, number of grains, and spike density. Indirect effects of those characteristics were low, which indicates that the mutual relations among them are weak.

Similar results were obtained by Weber [2008], who found significant, positive, direct effects of the mass of 1000 grains and grain number on the yield of wheat cultivars. On the other hand, low values of indirect effects of yield components, but for spring barely, were also obtained by Gozdowski *et al*. [2008a], although contrary to the present results, their values were negative.

CONCLUSIONS

1. Yield of spring wheat grown after white mustard was directly, significantly related only to spike length. Effect of the remaining characteristics was low and resulted mainly from their indirect effects. The greatest indirect effects were shown via spike density, mass of 1000 grains, and straw length.

2. Yield of spring wheat grown after tansy phacelia resulted from direct effects of the mass of 1000 grains, grain number, and spike density. The highest indirect effect on spring wheat yield was exerted via the mass of 1000 grains.

3. Path analysis in the evaluation of the determination of spring wheat yield is a method that allows the choice of the characteristics that have the strongest effect on yield variability.

REFERENCES

Brzozowska I., Brzozowski J., Hruszka M., 2008. Plonowanie i struktura plonu pszenicy ozimej w zależności od sposobu pielęgnacji i nawożenia azotem [Yield and yield structure of winter wheat depending on the tending method and nitrogen fertilization]. Acta Agrophys. 11, 597--611 [in Polish].

Deryło S., 1990. Badania nad regenerującą rolą poplonów ścierniskowych w płodozmianach o różnym udziale zbóż [Studies on the regenerating role of stubble after-crop in crop rotation with different cereal participation]. AR Lublin, Rozp. nauk. 17, 1-66 [in Polish].
Dofing M., Knight W., 1992. Alternative model for path analysis of small-grain yield. Crop. Sci. 32, 487-489.
Dzienia S., Boligłowa E. 1993. Rola mulczowania w podnoszeniu żyzności i urodzajności gleby [Role of mulching in increasing soil fertility and productivity]. Post. Nauk. Rol. 1, 107-111 [in Polish].
García del Moral L.F., Rharrabti Y., Elhani S., Martos V., Royo C., 2005. Yield formation in Mediterranean durum wheats under two contrasting water regimes based on path-coefficient analysis**.** Euphytica 146, 213-222
Garwood T., Davies D., Hartley A., 1999. The effect of winter cover crops on yield of the following spring crops and nitrogen balance in a calcareous loam. J. Agic. Sci. 132, 1-11.
Gołaszewski J., 1996. A method of yield component analysis. Biometrical Letters 33(2), 79-88.
Gozdowski D., Mądry W., 2008. Charakterystyka i empiryczne porównanie prostej oraz złożonej analizy ścieżek w ocenie determinacji plonu roślin przez ich cechy plonotwórcze. Cz. I. Prezentacja stosowanych metod [Characteristics and empirical comparison of simple and complex path analysis in the assessment of the yield determination of plants by their yield-forming characteristics. Part I. Presentation of the applied methods]. Biul. IHAR 249, 109-124 [in Polish].
Gozdowski D., Mądry W., Wyszyński Z., 2008a. Analiza korelacji i współczynników ścieżek w ocenie współzależności plonu ziarna i jego składowych u dwóch odmian jęczmienia jarego [Analysis of path correlations and coefficients in the assessment of the relations between grain yield and its components in two spring barely cultivars]. Biul. IHAR 248, 23-31 [in Polish].
Gozdowski D., Mądry W., Wyszyński Z., Kalinowska-Zdun M., 2008b. Charakterystyka i empiryczne porównanie prostej oraz złożonej analizy ścieżek w ocenie determinacji plonu roślin przez ich cechy plonotwórcze. Cz. II. Przykład z jęczmieniem jarym [Characteristics and empirical comparison of simple and complex path analysis in the assessment of the yield determination of plants by their yield-forming characteristics. Part II. Example with spring barley]. Biul. IHAR 249, 125-132 [in Polish].
Kuś J., Jończyk K., 1997. Oddziaływanie wybranych elementów agrotechniki na plonowanie pszenicy ozimej [Effect of chosen agrotechnical components on winter wheat yield]. Fragm. Agron. 3, 4-16 [in Polish].
Lepiarczyk A., 1999. Rośliny regerenujące w płodozmianach zbożowych [Regenerating plants in cereal crop rotation]. AR Kraków, Rozprawy 256 [in Polish].
Mohammad S., Prasanna B., Singh N., 2003. Seguential path model for determining inter-relationships among grain field and related characters in maize. Crop. Sci. 43, 1690-1697.
Podolska G., Sułek A., Stankowski S., 2002. Obsada kłosów – podstawowy parametr plonotwórczy pszenicy ozimej [Number of ears per area unit – main factor of winter wheat yield]. Acta Sci. Pol., Agricultura 1(2), 5-14.
Rozbicki J., 1997. Agrotechniczne uwarunkowania wzrostu, rozwoju i plonowania pszenżyta ozimego [Agrotechnical conditions of growth, development, and yield of winter triticale]. Fundacja „Rozwój SGGW" [in Polish].
Sabo M., Bede M., Hardi Z.U., 2002. Variability of grain yield components of some New Winter wheat genotypes (*Triticum aestivum*). Rost. Vyroba 48(5), 230-235.
Samborski S., Kozak M., Mądry W., Rozbicki J., 2005. Pierwotne cechy rozwojowe w analizie składowych plonu. Cz. II. Zastosowanie dla plonu ziarna pszenżyta ozimego [Primary developmental characteristics in yield component analysis. Part II. Application for winter triticale grain yield]. Fragm. Agron. 4(88), 84-95 [in Polish].
Samonte S., Wilson L., McClung A., 1998. Path analyses of yield-related trans of fifteen diverse rice genotypes. Crop. Sci. 38, 1130-1136.

Turska E., Wielogórska G., Czarnocki S., 2010. Rola międzyplonów ścierniskowych w monokulturowej uprawie pszenicy jarej [Role of stubble intercrop in the monoculture growth of spring wheat]. Ann. Univ. Mariae Curie-Skłodowska, Agricultura LXV(1), 90-96 [in Polish].
Weber R., 2008. Analiza komponentów plonu pszenicy ozimej w zależności od sposobu uprawy w warunkach wczesnych siewów [Analysis of winter wheat yield components depending on the growth method in the conditions of early sowings]. Ann. Univ. Mariae Curie-Skłodowska, Agricultura LXV(1), 90-96 [in Polish].
Zając T., Krawontka J., Szmigiel A., 1997. Oszacowanie determinacji plonu ziarna jęczmienia jarego na podstawie predykcji regresyjnej i zmienności elementów struktury plonu [Assessment of the determination of spring barely grain yield on the basis of regression prediction and variability of yield structure elements]. Zesz. Nauk. AR w Krakowie, Rolnictwo 34, 141-151 [in Polish].

OCENA DETERMINACJI PLONU PSZENICY JAREJ UPRAWIANEJ W MONOKULTURZE PRZERYWANEJ UPRAWĄ MIĘDZYPLONÓW ŚCIERNISKOWYCH Z WYKORZYSTANIEM ANALIZY ŚCIEŻEK

Streszczenie. Badania przeprowadzono w latach 2001-2004 w Rolniczej Stacji Doświadczalnej w Zawadach, należącej do Uniwersytetu Przyrodniczo-Humanistycznego w Siedlcach. Celem pracy była analiza wpływu niektórych cech pszenicy jarej, uprawianej w monokulturze, przerywanej uprawą międzyplonów ścierniskowych na jej plon. Wpływ wybranych komponentów plonu na plonowanie pszenicy jarej oceniono za pomocą metody analizy ścieżek. Stwierdzono, że w warunkach stosowania monokultury plon pszenicy jarej, uprawianej po gorczycy, determinowany był głównie przez długość kłosa, liczbę kłosków w kłosie, masę tysiąca ziaren i obsadę kłosów na 1 m^2. Plon pszenicy jarej uprawianej po facelii najsilniej determinowały: masa tysiąca ziaren, liczba ziaren w kłosie oraz obsada kłosów.

Słowa kluczowe: cechy plonotwórcze, efekty bezpośrednie zmiennych przyczynowych, efekty pośrednie zmiennych przyczynowych, komponenty plonu, międzyplony ścierniskowe

Accepted for print – Zaakceptowano do druku: 25.05.2012