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Full Length Article

Path Analysis on Effective Factors Affecting 305-D Milk Yield in Simmental Cattle

OZKAN GORGULU[1]
Ahi Evran University, Mucur Vocational High School, 40500, Kırşehir, Turkey
[1]Corresponding author's e-mail: ozkangorgulu@gmail.com

ABSTRACT

This study was done to evaluate the relationships between some features that affect milk yield in Simmental cattle and was aimed to determine the direct or indirect effects of these features on 305 days milk yield. In this study, the direct and indirect relationships between Simmental cattle's number of lactation (X_1), the age of animal (X_2), calving season (X_3), dry period (X_4), age in the first conception (X_5), age in the first calving (X_6), with 305 d milk yield (Y) was determined by path analysis. With this aim, milk yield records of 341 Simmental cattle were kept during the period of 2006-2009 at Gökhöyük state farm. According to the results, the relationships between calving season and 305 d milk yield were found to be weak or unimportant in all years (P>0.05). It was ascertained that the highest relationship between 305 d milk yield and the age of animal was obtained (r=0.712**). Also, there was a very significant positive relationship between the number of lactation and 305 d milk yield (P<0.01). It was determined that the number of lactation affects 305 d milk yield in the highest level directly by age variable S and indirectly throughout dry period. It was observed that the strongest one of these effects was direct effect.

Key Words: Path analysis; Correlation; Simmental; Milk yield

INTRODUCTION

The aim of animal improvement is the increasing animal yield in terms of the trait that is studied on. However, yield in animals is under the control of many factors. For this reason, to succeed with selection, it is important to determine, which factor affects the feature studied on and how affects it (Topal & Esenboğa, 2001; Hussain *et al.,* 2010). Statistically, the most important parameter of the relationships between variables is correlation coefficient. But just separately correlation coefficient is not a measure of the existence of a cause and effect relationship between variables (Keskin *et al.*, 2005). All the factors that affects yield does not have a direct impact on yield. Certain factors have impact indirectly as a result of the relationships between each other. For this reason, it is impossible for all relationships between yield and yield elements to be explained by correlation coefficients. In this respect, it is required that direct and indirect exposure ways must be divided from each other and relationships in question must be presented in detail (İşçi *et al.,* 2004). Path analysis is a standardized partial regression coefficient measuring the direct influence of one variable upon the other and permits separation of correlation coefficients into components of direct and indirect effects (Saleem *et al.,* 1999; Farhatullah, 2006; Ahsan *et al.*, 2008).

In this study, the direct and indirect relationships between Simmental cattle's number of lactation (X_1), the age of animal (X_2), calving season (X_3), dry period (X_4), age in the first conception (X_5), age in the first calving (X_6), with 305 d milk yield (Y) was tried to be determined with the help of path analysis.

MATERIALS AND METHODS

In this study, milk yield records of 341 Simmental cattle raised among 2006-2009 at Gökhöyük State Farm, which was the subject of General Directorate of Agricultural Enterprises were used as data. Path and correlation numbers were calculated by SPSS 15.0 and AMOS 7.0 packaged software.

Path coefficient was defined by (Wright, 1934) as equation 1; it is the part of standard deviation observed at dependent variable arising from independent variable when independent variables except the variable whose effect is determined are pegged. It is shown as below:

$$P_{yx} = b\ \frac{S_x}{S_y} \qquad (1)$$

Here; b shows partial regression coefficient.

In Path analysis, four different effects as direct, indirect, U and S between variables are defined. In this study, these effects will be defined shallowly. The detailed information about the calculation methods was given by (Şahinler & Görgülü, 2000). The hardest and the most important part of path analysis is creation the path diagram which determines the direction of the relationship between variables. At this point, there can be gotten some help from the views of this subject's experts and from the results of correlation analysis that will be made with variables. The path diagram that composed the subject of this study and belongs to data mentioned in material part (Fig. 1).

Considering the diagram, the effects between 305 d milk yield and factors affecting milk yield could be divided as follows: Path equations

$$r_{x_1y} = DE + IE + SE = p_{yx_1} + p_{x_4x_1} \cdot p_{yx_4} + p_{x_1x_2} \cdot p_{yx_2} \quad (2)$$

$$r_{x_2y} = DE + IE = p_{yx_2} + p_{x_1x_2} \cdot p_{yx_1} \quad (3)$$

$$r_{x_3y} = DE + IE = p_{yx_3} + p_{x_4x_3} \cdot p_{yx_4} \quad (4)$$

$$r_{x_4y} = DE + SE + SE = p_{yx_4} + p_{x_3x_4} \cdot p_{yx_3} + p_{x_4x_1} \cdot p_{yx_1} \quad (5)$$

$$r_{x_5y} = DE + IE = p_{yx_5} + p_{x_6x_5} \cdot p_{yx_6} \quad (6)$$

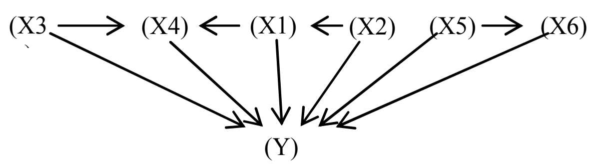
$$r_{x_6y} = DE + SE = p_{yx_6} + p_{yx_5} \cdot p_{x_6x_5} \quad (7).$$

RESULTS

According to these results, the in year 2009, the number of lactation was the lowest (2.67±1.60), while in 2007 it was the highest (3.25±1.86). When the age average of the animals was examined, it was ascertained that the youngest herd was in 2009 with 2497.52±724.87 days and the oldest herd was in 2006 with 3669.59±759.15 days. The average dry period of animals was the lowest (62.63±14.44) days in 2008 and the highest (69.08±14.17 days) in 2007. The age in the first conception was the lowest in 2008 (596.01±81.77) and the highest in 2007 (615.41±91.05). The age in the first calving was the lowest (888.25±105.61 days) in 2008 and the highest (927.26±125.18 days) in 2007. Observation on 305 d milk yield revealed that the lowest milk yield was in 2006 with 5100.48±935.27 kg and the highest in 2007 with 5506.49±1224.76 kg (Table I).

Data (Table II) exhibited positive relationship between number of lactation and 305-d milk yield in all years (P<0.01). There was a positive correlation between age and 305-d milk yield in all years (P<0.01). There was no association between calving season and 305-d milk yield (P>0.05). Data showed a negative relationship between dry period and 305 d milk yield in general. The relationships between these two variables observed only in 2007 was found to be very important statistically (P<0.01). The relationships observed in 2006, 2008 and 2009 were found to be insignificant (P>0.05). There was not a significant relationship between age in the first conception and 305-d milk yield (P>0.05). The relationship between these two variables was negative in all years. There was no relationship between age in the first calving and 305- d milk yield all through 2006 and 2009 (P>0.05).

Fig 1: Path diagram



Path coefficients indicated an important part of the effect that number of lactation had on 305- d milk yield was direct effect and then it was spurious effect (S effect) arising from age variable and at least there was a indirect effect over dry period (Table III). Relationship between age and 305 d milk yield revealed that the indirect effect of age over the number of lactation was more powerful than direct effect. There was a weak relationship between calving season and 305 d milk yield. The direct effect of calving season was more powerful than indirect effect over dry period. Dry period affected 305 d milk yield in three different ways; the most powerful one of these was direct effect. S effect arising from calving season and number of lactation was not as much as direct effect. The cause of negative relationship between age in the first conception mostly was the direct effect of the age in the first conception. Age at the first calving was effective in two ways; it was effective on 305 d milk yield directly and the S effect arising from age at the first calving. Nonetheless, the effect was more powerful in 2006, 2007 and 2008, S effect arising from age in the first conception was more powerful in 2009.

DISCUSSION

In animal breeding, it is preferred that a cow was milks for 10 months before leaving for the dry period. Akman (1998) has determined ideal dry period as 45-60 days. Alpan (1992) reported that dry period is over 60 days, milk yield can reduce. Bakır and Çetin (2003) reported that dry period affects milk yield for 72–123 days in locally while this period is 60-69 days globally. Koçak *et al.* (2007) have asserted that the average dry period was 86.93±2.23 days in their study in Holstein cows. In this study, average dry period was found as 62.63±14.44 (2008) to 69.08±14.17 (2007) days, which is ideal. These data showed that cows in Gökhöyük State Farm were allocated dry period on time. To put in dry period on time is useful for both the health of cow and economic advantage of the enterprise (Bakır & Çetin, 2003). Duru and Tuncel (2004) reported the age at the first conception as 14-16 months and age at the first calving as 24-26 months. Koçak *et al.* (2008) reported the age at the first calving as 861.90 days. In this study, age at the first conception was 596.01-615.41 days. The average age at the first calving was between 888.25 and 927.26 days.

Table I: Descriptive statistics for different variables used in the path analysis

Year	Characters	N	Mean	Min.	Max.
	Number of lac. (X_1)	115	2.67±1.60	1	8
	Age(X_2)	115	2497.52±724.87	1627	4875
2009	Dry period (X_4)	115	67.58±16.60	16	131
	Age in the first conception (X_5)	115	600.97±66.23	403	978
	Age in the first calving (X_6)	115	900.06±78.72	682	1213
	305- d milk yield (Y)	115	5319.62±1106.67	2518	8053
	Number of lac. (X_1)	71	2.69±1.86	1	11
	Age(X_2)	71	2847.92±820.67	1910	5678
2008	Dry period (X_4)	71	62.63±14.44	34	107
	Age in the first conception (X_5)	71	596.01±81.77	414	909
	Age in the first calving (X_6)	71	888.25±105.61	600	1189
	305-d milk yield (Y)	71	5305.18±972.50	3299	7228
	Number of lac. (X_1)	73	3.25±1.86	1	10
	Age(X_2)	73	3436.34±741.88	2519	5678
2007	Dry period (X_4)	73	69.08±14.17	30	96
	Age in the first conception (X_5)	73	615.41±91.05	414	909
	Age in the first calving (X_6)	73	927.26±125.18	690	1262
	305- d milk yield (Y)	73	5506.49±1224.76	3079	7925
2006	Number of lac. (X_1)	82	3.05±1.99	1	10
	Age(X_2)	82	3669.59±759.15	2620	5679
	Dry period (X_4)	82	66.17±16.25	21	98
	Age in the first conception (X_5)	82	597.43±65.67	414	815
	Age in the first calving (X_6)	82	899.57±78.21	717	1095
	305- d milk yield (Y)	82	5100.48±935.27	2832	7430

Table II: Correlation coefficients between factors affecting milk yield in jersey cattle

Years		Characters	X_2	X_3	X_4	X_5	X_6	Y
2009	X_1	Number of Lac.	0.973**	-0.007	0.214*	-0.295**	-0.156	0.346**
	X_2	Age	1	-0.048	0.091	0.107	0.094	0.644**
	X_3	Calving season		1	0.123	0.114	0.143	-0.125
	X_4	Dry period			1	-0.084	0.037	-0.171
	X_5	Age at the first conception				1	0.629**	-0.146
	X_6	Age at the first calving					1	-0.111
2008	X_1	Number of Lac.	0.968**	0.195	0.164	-0.065	-0.069	0.246*
	X_2	Age	1	0.218	0.061	0.139	0.113	0.532**
	X_3	Calving season		1	-0.041	0.066	0.060	-0.117
	X_4	Dry period			1	0.027	-0.019	0.015
	X_5	Age at the first conception				1	0.631**	-0.097
	X_6	Age at the first calving					1	0.021
2007	X_1	Number of Lac.	0.948**	0.020	0.365**	-0.322**	-0.236*	0.453**
	X_2	Age	1	0.018	0.039	0.156	0.118	0.344**
	X_3	Calving season		1	0.043	0.101	0.191	0.103
	X_4	Dry period			1	-0.190	-0.042	-0.390**
	X_5	Age at the first conception				1	0.654**	-0.089
	X_6	Age at the first calving					1	-0.118
2006	X_1	Number of Lac.	0.957**	-0.052	0.298*	-0.344**	-0.405**	0.459**
	X_2	Age	1	-0.049	0.047	0.211	0.168	0.712**
	X_3	Calving season		1	0.171	0.103	-0.016	-0.148
	X_4	Dry period			1	0.306**	0.240*	-0.141
	X_5	Age at the first conception				1	0.549**	-0.154
	X_6	Age at the first calving					1	-0.039

* and **, significant 5% and 1% level, respectively

In general there was a negative relationship between 305 d milk yield and dry period. Only the relationship observed in 2007 between these two variable was found very significant ($P<0.01$). The relationships observed between 2006, 2008 and 2009 was found unimportant ($P>0.05$). There were three different effects between dry period and 305 d milk yield. The most powerful one of these was direct effect. Söğüt and Bakır (1999) noted significant ($P<0.01$) relationship between dry period and 305 d milk yield.

There was no correlation ($P>0.05$) amongst the years when computed for the age at the first calving and 305 d milk yield. Duru and Tuncel (2004) and Pantelic *et al.* (2008) reported no association between age at the first calving and 305 d milk yields. The age at the first calving affects 305 d milk yield in two different ways; directly and S effect that arising from age at the first conception. The direct effect was more effective in 2006, 2007 and 2008, while S effect was stronger in 2009. There was no relationship between calving season and 305-d milk yield ($P>0.05$). Bakır and Çetin (2003) stated that the effect of calving season on 305-d milk yield was unimportant

Table III: Path coefficients between factors affecting milk yield in the jersey cattle

Pathways	2006	2007	2008	2009
The relations of number of lactation (X_1) and 305 d milk yield (Y)				
Direct effect	0.251	0.264	0.112	0.176
Indirect effect over dry period	0.067	0.064	0.083	0.069
S effect arising from age variable	0.141	0.125	0.051	0.092
Error	0.000	0.000	0.000	0.009
Total correlation	0.459**	0.453**	0.246*	0.346**
The relations of age (X_2) and 305 d milk yield (Y)				
Direct effect	0.301	0.146	0.184	0.313
Indirect effect over the number of lactation	0.411	0.193	0.348	0.327
Error	0.000	0.005	0.000	0.004
Total correlation	0.712**	0.344*	0.532**	0.644**
The relations of season (X_3) and 305 d milk yield (Y)				
Direct effect	-0.128	0.120	-0.116	-0.105
The indirect effect over dry period	-0.020	-0.016	-0.001	-0.019
Error	0.000	0.000	0.000	0.001
Total correlation	-0.148	0.103	-0.117	-0.125
The relations of dry period (X4) and 305 d milk yield (Y)				
Direct effect	-0.095	-0.400	0.002	-0.157
S effect arising from calving season	-0.021	0.005	0.005	-0.012
S effect arising from number of lactation	-0.024	0.004	0.007	-0.001
Error	0.000	0.000	0.001	0.001
Total correlation	-0.141	-0.390**	0.015	-0.171
The relations of age at first conception (X_5) and 305 d milk yield (Y)				
Direct effect	-0.251	-0.291	-0.183	-0.126
The indirect effect over age at the first calving	0.097	0.202	-0.086	-0.019
Error	0.000	0.170	0.000	0.000
Total correlation	-0.154	-0.089	-0.097	-0.146
The relations of age at the first calving (X_6)and 305 d milk yield (Y)				
Direct effect	0.177	-0.309	0.137	-0.031
S effect arising from age at the first conception	-0.137	0.190	-0.115	-0.079
Error	0.000	0.000	0.000	0.000
Total correlation	-0.039	-0.118	0.021	-0.111

(P>0.05). Koçak *et al.* (2007) confirmed that calving season had no effect on dry period. In our study, we confirmed that there was no correlation between dry period and calving season (P>0.05). Studies show that the number of lactation affects drier period markedly (Çilek & Tekin, 2005; Çilek & Bakır, 2010; Habib *et al*., 2010). In our study, there was an important and positive relationship between the number of lactation and dry period in 2006, 2007 and 2009 (P<0.01).

CONCLUSION

Path analysis provides a useful technique for modeling. Correlation and path coefficient analysis showed the importance of number of lactation, age, calving season, dry period, age at the first conception and age at the first calving for the 305 d milk yield in Simmental cattle. The number of lactation and age affect significantly 305-d milk yield. The effects of the number of lactation on 305-d milk yield were direct, S effect arising from age variable and the indirect effect making over dry period had greater significance. Similarly, the direct effect and indirect effect of age on 305 d milk yield were significant.

REFERENCES

Ahsan, M., M.Z. Hader, M. Saleem and M. Alsam, 2008. Contribution of various leaf morpho-physiological parameters towards grain yield in maize. *Int. J. Agric. Biol.,* 10: 546–550

Akman, N., 1998. *Practical Cattle Breeding*. Foundation of the Turkish Union of Agricultural Engineers Publication, Ankara, Türkiye

Alpan, O., 1992. *Cattle Breeding and Fattening*. Şahin Press, Ankara, Türkiye

Bakır, G. and M. Çetin, 2003. Breeding characteristics and milk yield traits of holstein cattle in Reyhanlı agricultural facility. *Turkish J. Vet. Anim. Sci*., 27: 173–180

Çilek, S. and M.E. Tekin, 2005. Environmental factors affecting milk yield and fertility traits of simmental cows raised at the Kazova state farm and phenotypic correlations between these traits. *Turkish J. Vet. Anim. Sci*., 29: 987–993

Çilek, S. and G. Bakır, 2010. Milk yield traits of Brown cows reared at Malya State Farm and effects of some environmental factors on these traits. *J. Vet. Medicine University of Kafkas*, 16: 347–350

Duru, S. and E. Tuncel, 2004. The correlations between dry period, service period and age at first calving with some milk yield traits in holstein friesian cattle. *J. Uludağ Univ. Agric. Fac*., 18: 69–79

Farhatullah, F., E. Azam and I.H. Khalil, 2006. Path Analysis of the Coefficients of Sunflower (*Helianthus annuus*L.) Hybrids. *Int. J. Agric. Biol*., 8: 621–625

Habib, M.A., M.A. Afroz and A.K.F.H. Bhuiyan, 2010. Lactation performance of Red Chittagong Cattle and effects of environmental factors. *The Bangladesh Vet.,* 27: 18–25

Hussain, M., A. Ghafoor and A. Saboor, 2010. Factors affecting milk production in buffaloes: a case study. *Pakistan Vet. J.,* 30: 115–117

İşçi, Ö., Ç. Takma and Y. Akbaş, 2004. Study on factors effecting 305-day milk production of holstein friesian using path analysis. *In*: *4th National Science Congress of Zootechnics*, p: 578. Isparta, Türkiye

Keskin, İ., B. Dağ and Ö. Şahin, 2005. Investigation of relationships between body measurements taken at the onset of the fattening period and warm carcass weights in Anatolian Merino male lambs by Path analysis. *J. Livestock Res.,* 15: 6–10

Koçak, S., B. Yüceer, M. Uğurlu and C. Özbeyaz, 2007. Some Production Traits of Holstein Cows Reared in Bala State Farm. *J. Lalahan Livestock Cent. Res. Inst.,* 47: 9–14

Koçak, S., M. Tekerli, C. Özbeyaz and İ. Demirhan, 2008. Some Production Traits of Holstein, Brown-Swiss and Simmental Cattle Reared in Lalahan Livestock Research Institute. *J. Lalahan Livestock Cent. Res. Inst.,*48: 51–57

Pantelic, V., M.M. Petrovic, S. Aleksic, D. Ostojic, L. Sretenovic and Z. Novakovic, 2008. Genetic correlations of productive and reproductive traits of Simmental cows in Republic of Serbia. *Arch. Zootech.,* 11: 73–78

Saleem, M., S. Ali, M. Yousuf and W.A.A. Haris, 1999. Path Coefficient Analysis of seed yield and quantitative traits in Chickpea (*Cicer arietinum L.*). *Int. J. Agric. Biol.,* 1: 106–107

Söğüt, B. and G. Bakır, 1999. The effect of dry period on the milk yield traits in Holstein Friesian Cattle. *In*: *GAP 1st Congress of Agriculture*, p: 1051. Şanlıurfa, Türkiye

Şahinler, S. and Ö. Görgülü, 2000. Path analysis and an application. *J. Agric. Fac. MKU*, 5: 87–102

Topal, M. and N. Esenboğa, 2001. A study on direct and ındirect effects of some factors on weaning weight of a awassi lambs. *Turkish J. Vet. Anim. Sci.*, 25: 377–382

Wright, S., 1934. The Method of Path Coefficients. *In*: Carver, H.C. and A.L. O'toole (eds.), *Ann Mat. Statist*, pp: 161–215. Edwards Brothers Inc., Michigan

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