

STUDY OF THE RELATIONSHIP BETWEEN LEAF SURFACE, GRAIN YIELD AND OIL PERCENT IN DIFFERENT VARIETIES OF SUNFLOWER

A. MORADI and P. VOJDANI
(Iran)

Establishing a relationship between leaf area, grain yield and oil percent in sunflower is useful for the prediction of yield. It can aid in the selection by breeders and also be helpful in arriving at recommendations for proper cultural practices. This study has been conducted to determine the relations between the above mentioned characters.

MATERIALS AND METHODS

In two regions of Iran named Karaj and Gorgan which are characterised by different climates, the study was conducted for four years with five varieties. The varieties were Rekord, Mayak, VNIIMK 8931, N.S.P. 317 and N.S.P. 61. The description of the climates is given in table 1. Observations were made, in each region, on ten plants of each variety chosen at random, replicated three times.

Leaf area was determined and the average of ten plants accepted as the figure representing the leaf area for each plot, by measuring the length and the width of each leaf and multiplying their product by a fixed coefficient 0.77 (method proposed by two Russian researchers named Lazarov and Sestak). The yield of each plot (2.8 x 5m) was weighed and adjusted to 13 percent moisture. To measure oil percent, two samples were taken at random from each plot and the oil content determined by Soxhlet method.

Regression and correlation coefficients were calculated and an analysis of covariance was done to find out the effect of the factors of regions, years and varieties separately (tables 2—10).

DISCUSSION

It was found that oil percent has a negative correlation with leaf surface but the correlation of grain yield and leaf surface is positive.

Table 1

Climate data

Region	Month	Temperature												Relative humidity			Precipitation m/m					
		Min.						Max.						Mean								
		70	71	72	73	70	71	72	73	70	71	72	73	70	71	72	73	70	71	72	73	
Karaj	April	0	6	7	5	27	18	21	21	16	12	14	13	62	78	55	45	5	78	15	33	
	May	3	13	12	9	34	28	21	28	21	20	17	18	55	77	66	43	0	10	7	3	
	June	6	12	14	13	37	31	30	35	24	21	22	24	48	60	60	40	0	0	2	0	
	July	12	17	16	15	37	35	34	37	26	26	25	26	61	40	48	44	0	0	0	0	
Gorgan	April	9	12	12	10	31	20	24	22	17	16	18	16	68	67	61	64	28	52	60	23	
	May	14	22	15	15	44	28	24	28	23	25	19	22	57	60	66	62	11	9	171	21	
	June	16	24	21	19	34	30	32	29	25	27	27	24	63	55	61	—	10	34	25	28	
	July	22	29	24	22	38	34	34	32	27	31	29	27	58	52	60	—	37	0	7	4	
Gorgan	August	22	27	22	24	36	32	33	33	28	30	27	28	70	59	56	—	25	15	47	—	

Table 2

General regression

Y	Reg. & corr. coefficient	(Y, X) + year region variety	(Y, X) + year region variety	(Y, X) + variety	(Y, X) + year	(Y, X) + region
Oil %	b	-0.000517	-0.001664	-0.000096	-0.000354	-0.001931
	t	-1.45124	-6.5565**	-2.35612*	-1.11148	-7.02653**
	r _{xy}	-0.052	-0.7224**	-0.3698*	-0.1873	-0.7789**
Yield ha	b	+0.000305	+0.000123	+0.000046	+0.000177	+0.000054
	t	+0.8411	+2.47344*	+0.75964	+2.07995*	+1.29257
	r _{xy}	+0.014	+0.36801*	+0.1274	+0.3345*	+0.2231
Oil ha	b	-0.003124	+0.000007	-0.000075	-0.000013	-0.000036
	t	-4.53148**	+0.27406	-2.56729*	-0.30677	-1.85093(+)
	r _{xy}	-0.628**	+0.0403	-0.3974*	-0.0511	-0.3097(+)

** = Significant at 1%
 * = Significant at 5%
 (+) = Significant at 10%

Table 3

Variety : Rekord

Y	Reg. & corr. coefficient	(Y, X) - year region	(Y, X) + year region	(Y, X) + year	(Y, X) + region
Oil %	b	+0.000158	-0.001216	-0.000365	-0.001705
	t	+0.10436	-3.38951**	-0.74931	-4.67172 **
	r _{xy}	+0.0240	-0.57711**	-0.1576	+0.7222 **
Yield ha	b	+0.000539	+0.000183	+0.000229	+0.000169
	t	+3.42643**	+4.60364**	+4.09650 **	+3.85018 **
	r _{xy}	+0.6179**	+0.69196**	-0.6572 **	+0.6520 **
Oil ha	b	+0.00025	+0.000049	+0.000097	+0.000028
	t	+2.67269*	+2.23211*	+3.39993 **	+1.08574
	r _{xy}	+0.5212 *	+0.4220*	+0.5832**	+0.2304

** = Significant at 1%

* = Significant at 5%

(+) = Significant at 10%

Table 4

Variety : VNIIMK 8931

Y	Reg. & corr. coefficient	(Y, X) - year region	(Y, X) + year region	(Y, X) + year	(Y, X) + region
Oil %	b	-0.000519	-0.000903	0.000311	-0.001646
	t	-0.82995	-2.47074*	0.78130	-5.14427 **
	r _{xy}	-0.1868	-0.45793*	0.1643	-0.7546 **
Yield ha	b	+0.000114	+0.000146	+0.000286	+0.000046
	t	+0.82000	+2.00325 (+)	+2.85011**	+0.74655
	r _{xy}	+0.1842	+0.38357 (+)	+0.5188 **	+0.1648
Oil ha	b	-0.000017	+0.000034	+0.000123	-0.000034
	t	-0.24164	+0.87937	+2.41689 *	-1.06749
	r _{xy}	-0.0529	+0.17944	0.4558 *	-0.2320

** = Significant at 1%

* = Significant at 5%

(+) = Significant at 10%

Table 5

Variety : Mayak

Y	Reg. & corr. coefficient	(Y, X) - year region	(Y, X) + year region	(Y, X) + year	(Y, X) + region
Oil %	b	-0.001105	-0.001235	-0.000476	-0.001894
	t	-2.61259 *	-4.43768 **	-1.75547 (+)	-7.25886 **
	r _{xy}	-0.5140 *	-0.67908 **	-0.3540 (+)	-0.8512 **
Yield ha	b	+0.000252*	+0.000167	+0.000307	+0.000060
	t	+2.70641 *	+2.60678*	+4.28598 **	+1.03827
	r _{xy}	+0.5274 *	+0.47710 *	+0.6747 **	+0.2250
Oil ha	b \bar{I}	+0.000073	+0.00004	+0.000127	-0.000031
	t	+1.47353	+1.19035	+3.50279 **	-1.07680
	r _{xy}	+0.3185	+0.2402	+0.5966 **	-0.2346

** = Significant at 1%

* = Significant at 5%

(+)= Significant at 10%

Table 6

Variety : NSP-317

Y	Reg. & corr. coefficient	(Y, X) - year region	(Y, X) + year region	(Y, X) + year	(Y, X) + region
Oil %	b	-0.001187	-0.001419	-0.000516	-0.001872
	t	-5.91739 **	-4.64217 **	-1.62451	-8.21666 **
	r _{xy}	-0.8048 **	-0.69538 **	-0.3268	-1.8782 **
Yield ha	b	+0.000031	+0.000041	-0.000017	+0.000071
	t	+0.37773	+0.82708	-0.24292	+1.49187
	r _{xy}	+0.0842	+0.16897	-0.0519	+0.3166
Oil/ha	b	-0.000022	-0.000028	-0.000025	-0.000028
	t	-0.56186	-1.20519	-0.73942	-1.25137
	r _{xy}	-0.1266	-0.23718	-0.1525	-0.2621

** = Significant at 1%

* = Significant at 5%

(+)= Significant at 10%

Table 7

Variety : NSP-61

Y	Reg. & corr. coefficient	(Y, X) - year region	(Y, X) + year region	(Y, X) + year	(Y, X) + region
Oil %	b	-0.001415	-0.001736	-0.001079	-0.002288
	t	-7.08386 **	-3.09045 **	-3 60413 **	-3.53349 **
	r _{xy}	-0.8514 **	-0.54158 **	-0.6093**	-0.6200 **
Yield ha	b	-0.000326	-0.000124	-0.000176	-0.000197
	t	-11.07783**	-1.34761	-1.74064(+)	-3.58444 **
	r _{xy}	-0.9299 **	-0.27004	-0.3473 (+)	-0.6242 **
Oil/ha	b	-0.000199	-0.000108	-0.000115	-0.000160
	t	-17.2109 **	-2.51994 *	-2.45713 *	-7.70588**
	r _{xy}	-1 **	-0.46216 *	-0.4614 *	-0.8639 **

** = Significant at 1%
 * = Significant at 5%
 (+) = Significant at 10%

Table 8

Y : Oil/ha. X : Leaf surface

Year	Region	Rekord	VNIMK 8931	Mayak	NSP. 317	NSP. 61	Ave. region	Ave. year
1970	Gorgan	1.680 6749	1.836 7446	1.735 5924	1.890 7246	1.836 2581	1.795 5989.20	1.641
	Karaj	1.422 4688	1.509 4254	1.520 4209	1.523 3645	1.462 4065	1.487 4172.2	5080.7
1971	Gorgan	1.395 5657	1.217 6026	1.247 4887	1.282 5980	1.295 5026	1.287 5515.20	1.419
	Karaj	1.514 2780	1.438 3035	1.544 3175	1.704 3207	1.563 3037	1.552 3046.80	4281.0
1972	Gorgan	1.647 6898	1.680 5966	1.749 6366	1.638 4413	1.655 4159	1.673 5560.9	1.738
	Karaj	1.537 4851	1.920 4945	1.903 3992	1.765 3548	1.895 3397	1.804 4146.0	4853.4
1973	Gorgan	1.325 5320	1.099 5107	1.236 4725	1.488 6982	0.915 4670	1.212 5360	1.352
	Karaj	1.361 2578	1.645 2946	1.494 2119	1.660 2931	1.303 2604	1.492 2635	3997
Ave.		1.485	1.543	1.380	1.619	1.490	1.491 5606	
Var.		4940	4965	4424	4744	3692	1.513 3500	

Table 9

Y : Yield/ha. X : Leaf surface

Year	Region	Rekord	VNIIMK 8931	Mayak	NSP. 317	NSP. 61	Ave. region	Ave. year
1970	Gorgan	3.726 6749	4.018 7446	3.813 5924	4.093 7246	3.921 2581	3.914 5989.20	3.431
	Karaj	2.864 4688	3.083 4254	3.000 4209	2.974 3645	2.814 4065	2.947 4172.2	5080.7
1971	Gorgan	3.086 5657	2.780 6026	2.733 4887	2.874 5980	2.828 5026	2.860 5515.20	2.960
	Karaj	3.015 2780	2.854 3035	3.077 3175	3.358 3207	2.984 3037	3.057 3046.80	4281.0
1972	Gorgan	3.656 6898	3.697 5966	3.699 6366	3.716 4413	3.593 4159	3.672 5560.9	3.718
	Karaj	3.390 4851	4.005 4945	3.897 3992	3.670 3548	3.856 3397	3.763 4146.0	4853.4
1973	Gorgan	3.102 5320	2.699 5107	2.760 4725	3.529 6982	2.194 4670	2.856 5360	2.858
	Karaj	2.569 2578	3.250 2946	2.832 2119	3.166 2931	2.484 2604	2.860 2635	3997
Ave.		3.176	3.298	3.226	3.422	3.084	3.325 5606	
Var.		4940	4965	4424	4744	3692	3.157 3500	

No meaningful correlation was observed between leaf surface and oil yield. In studying the influence of regions, years and varieties independently it was observed that regions and varieties had a considerable effect on the relationship of leaf surface and oil percent, while the relationship of leaf surface and grain yield was only affected by years. It was concluded therefore that for more accurate results the above relationship should be determined for each variety and region separately. When varieties were studied, the results showed that in the varieties Rekord and VNIIMK 8931 there is no correlation between leaf area and oil percent; it is probable that a meaningful correlation can be found for a particular region between leaf area and oil percent. In the varieties Mayak, N.S.P. 317 and N.S.P. 61, when the influence of years and regions are omitted, a negative correlation is observed between oil percent and leaf area. When these factors are studied independently, the result shows that in Mayak and N.S.P. 317 the effect of years may reduce the correlation of leaf area and oil percent. In the variety N.S.P. 61 years

Table 10

Y : Oil % X : Leaf surface

Year	Region	Rekord	VNIIMK 8931	Mayak	NSP. 317	NSP. 61	Ave. region	Ave. year
1970	Gorgan	45.08 6749	45.70 7446	45.50 5924	46.18 7246	46.82 2581	45.856 5989.20	48.176
	Karaj.	49.65 4688	48.95 4254	50.65 4209	51.22 3645	51.97 4065	50.488 4172.2	5080.7
1971	Gorgan	45.19 5657	43.76 6026	45.64 4887	44.62 5980	45.78 5026	44.998 5515.20	47.889
	Karaj	50.22 2780	50.40 3035	50.17 3175	50.73 3207	52.38 3037	50.78 3046.80	42.810
1972	Gorgan	45.04 6898	45.44 5966	47.28 6366	44.08 4413	46.05 4159	45.578 5560.9	46.729
	Karaj	45.33 4851	47.93 4945	48.84 3992	48.19 3548	49.15 3397	47.88 4146.0	4853.4
1973	Gorgan	42.72 5320	40.74 5107	44.79 4725	42.17 6982	41.72 4670	42.42 5360	47.33
	Karaj	52.97 2578	50.61 2446	52.76 2119	52.43 2931	52.46 2604	52.24 2635	39.97
Ave		47.02	46.69	48.20	47.45	48.29	44.71	
Var.		4940	4965	4424	4744	3692	5606 50.35 3500	

and regions influence the above mentioned relationship, but not to the same extent.

The correlation of leaf area and yield is also not the same for all varieties.

In the varieties Rekord, Mayak and N.S.P. 61, the correlation of leaf area and grain yield is not influenced by years and regions. Nevertheless, in Mayak the factor of region and in N.S.P. 61 years appear to have a slight effect toward reducing the correlation. For the varieties N.S.P. 317 and VNIIMK 8931 no correlation was observed when the effects region and years were not considered. However, in VNIIMK 8931, where the factor of year was considered, the correlation of leaf area and grain yield became significant. In other words in some years the correlation might be found to be significant in this variety, in contrast with other varieties, the correlation of leaf surface and grain yield in N.S.P. 61 was found to be negative and increasing the leaf area in this variety not only diminished oil percent but grain yield too. The corre-

lation of leaf surface and oil yield was found to be positive for the variety Rekord in one region and negative for N.S.P. 61 in both regions.

CONCLUSION

A negative correlation exists for oil percent and leaf surface in the varieties Mayak, N.S.P. 317 and N.S.P. 61 but this correlation is not the same against the influence of years and regions. In the variety Mayak and N.S.P. 317 the correlation is different in different years but in N.S.P. 61 neither years nor region have considerable influence on the correlation. In varieties such as Rekord a correlation might be found in some particular region.

The correlation of leaf surface and grain yield also is not the same for all varieties. For instance in the varieties Rekord, Mayak, leaf area and grain yield have a positive correlation but in the variety N.S.P. 61 the correlation is negative. The factors of region and years have no effect on the correlation in the variety Rekord, while in Mayak the factor of region and in N.S.P. 61 the factor of years slightly reduce it.

The correlation of leaf area and oil yield in variety Rekord is positive and stable for any particular region. In variety N.S.P. 61 it is negative and not influenced by years and regions.

More research is needed to establish conclusively the relationship between leaf area, oil percent and grain yield for different varieties of sunflower (if the obtained results will be confirmed by more trials and research it becomes conclusively clear that in some varieties, increasing the leaf surface causes increasing grain yield and oil yield, and in some varieties increasing of leaf area is combined with decreasing of grain yield and oil yield). Such information helps the agronomist a great deal in recommending proper varieties as well as suitable cultural practices for different areas (it may well be that highly productive varieties with smaller leaf surfaces are more suitable for dry conditions because of less evapotranspiration).