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Effect of defoliation on source-sink relationship in groundnut (*Arachis hypogaea* L.)

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Abstract
A field investigation was taken up in groundnut variety Kadiri-6 to study the effect of defoliation on source sink relationship at Regional Agricultural Research Station, PJTSAU, Palem for two consecutive years *i.e. Kharif,* 2015 and *Kharif,* 2016. Defoliation was practiced at 90 DAS. Out of the five treatments, no defoliation has given best results over other four defoliation treatments. Among the two years 2015, 2016 and pooled, lower values were registered as the intensity of defoliation increased for all the characters. Near to zero values were registered for leaf area and leaf mass in 100 defoliation. For shoot mass (g/plant), root mass (g/plant), pod yield per plant (g/plant) and pod mass per plant (g/plant), among two years 2015, 2016 and pooled analysis, pod mass was highest in no defoliation followed by 25%, 50% and 75 % levels of defoliation. The lowest pod mass per plant was recorded in severe (100%) defoliation. The moderate and severe defoliation treatments significantly reduced all characters. Defoliation reduced the dry weight of root, shoot and pod mass. The adverse effect of defoliation was more pronounced when defoliation was complete than when half of the number of leaves were removed. The greatest reduction in yield occurred when the plants were defoliated during the early pod stage. Hence, in ground nut variety Kadiri - 6, no defoliation is the best to practice in realizing more pod yield per plant than defoliation.

Keywords: defoliation, source sink relationship, groundnut

Introduction
Groundnut (*Arachis hypogaea* L.) is one of the most important legumes providing significant amounts of oil (50 to 65%) and proteins (25 to 35%), livestock fodder and improves soil fertility. During production, crops may be damaged by hail, leaf feeders and defoliators, leaf diseases; besides loss in functional area due to wind, drought, grazing of animals, removal of leaves for fodder and as leafy vegetable etc. Degree of yield reduction is directly proportional to percentage of leaf area destroyed and varies depending upon variety, crop growth stage, population and intensity of foliage loss. Knowledge of defoliation that causes slight yield reduction but provides significant advantage to quantity of fodder obtained either for livestock feeding or for green manure is of paramount importance. Groundnut grown under rainfed situation, yield limitation is due to improper distribution of photo assimilates from source to sink. Investigations on the source-sink relationship through manipulation of source size have shown that partial defoliation enhanced carbon dioxide exchange rate of intact leaves (Hanson and West, 1982) [4] and dependent on the relative position of the leaves to the developing fruits (Boote *et al.,* 1980) [1]. In ground nut, defoliation to different degrees and at different stages of growth, decreased the stem and pod growth rates (Williams *et al.,* 1976) [9]. During early weeks of defoliation reduction in CO^2 exchange rate occurred, but was followed by partial recovery at a later stage (Jones *et al.*, 1982) [5]. However, no efforts were made to identify the importance of leaves in relation to position of branches and their relation to growth of plant. Defoliation treatment imposes a shock-effect on the plant and recovery mechanism operates followed by the development of compensatory leaves. Another way, by which photosynthetic surface could be reduced is by covering the leaves without causing injury to the plants. Reports regarding comparative studies on defoliation and covering are rather meager. Keeping the above in view, an experiment was designed to unravel the source-sink relationship and dry mater partitioning and to study influence of defoliation on physiological growth parameters yield and yield attributes in groundnut.

Material and Methods
The investigation was carried out on popular groundnut variety Kadiri-6 in RBD replicated thrice at at Regional Agricultural Research Station, PJTSAU, Palem for two consecutive years *i.e. Kharif,* 2015 and *Kharif,* 2016.

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All the package of practices was followed to raise the healthy crop. Four treatments (T_1: no defoliation (Control); T_2: 25% defoliation; T_3: 50% defoliation; T_4: 75% defoliation; and T_5: 100% Defoliation) were adopted, Defoliation was carried out at 90 DAS in all the treatments. Observations were recorded at harvesting stages on leaf area (Cm^2/plant), leaf mass (g/plant), shoot mass (g/plant), root mass (g/plant), pod yield per plant (g/plant) and pod mass per plant (g/plant). The data was analyzed for RBD ANOVA for 215, 2016 and pooled by method following Panse and Sukhatme, 1985 [7] for all the parameters.

Results and Discussion

Analysis of variance revealed significant differences (p>0.05) among the different defoliation levels on Kadiri-6 variety of groundnut on all the six parameters studied revealing the each treatment was effective over the parameters.

Assimilate availability and allocation to reproductive structures is an important factor which determines yield of any crop. Leaf is the major source of supplying assimilates to developing organs, young pods and seeds in crops (Barimavandi *et al*., 2010) [2]. Leaf removal may, therefore, influence TDM production and yield through photosynthate production and distribution into different parts depending on the magnitude of leaf removal. Among all the treatments, no defoliation *i.e*. control (Table 1) performed best in general for all the characters. Among the two years 2015, 2016 and pooled, lower values were registered as the intensity of defoliation increased. Near to zero values were registered for leaf area and leaf mass in 100 defoliation.

Highest root mass (108.78g per plant) was observed in no defoliation (Table 1) followed by 25%, 50% and 75% defoliation treatments. Lowest shoot mass was noticed in 100% defoliation. With respect to root mass, maximum values were noticed in 25% defoliation (10.83g per plant) followed by 100% defoliation (6.78 g per plant) in pooled analysis. Similar trend was also observed among 2015 and 2016 years.

In 2015, highest number of pods per plant (23.67g per plant) was observed in no defoliation followed by 50%, 75% and 100% defoliation levels. Similar results were also observed in 2016. The pooled analysis also evidenced with a highest of 22.67 pods per plant in control followed by 25%, 50% and 75 % levels of defoliation. The lowest pods were observed in severe most defoliation (100%). The results are in agreement with the results of Enyi, 1975 who reported that groundnuts were least affected by plant defoliation; percentage reduction in yield being 59.7 79.0, and 86.4% in groundnut, cowpea and soybeans.

Table 1: Effect of defoliation studies on leaf area (cm^2/plant), leaf mass (g/plant) and shoot mass (g/plant) ground nut variety Kadiri-6

	Treatment	Leaf area (cm^2/plant)			Leaf mass (g/plant)			Shoot mass (g/plant)		
		2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled
1	Control	16932.72	15633.70	16283.21	61.33	58.33	59.83	110.23	107.33	108.78
2	25% Defoliation	11679.00	10897.00	11288.00	33.00	30.00	31.50	82.33	79.33	80.83
3	50 % Defoliation	8946.67	7896.67	8421.67	28.00	27.60	27.80	21.00	19.80	20.40
4	75% Defoliation	555.00	618.00	586.50	11.00	9.53	10.27	15.00	14.60	14.80
5	100 % Defoliation	0.00	0.00	0.00	0.00	0.00	0.00	9.00	7.50	8.25
	Mean	7622.68	7009.08	7009.08	26.67	25.09	25.88	47.53	45.71	46.62
	C.D at 5%	130.17	128.64	129.41	5.35	1.28	3.31	4.32	0.37	2.34
	SE(m)	52.00	56.00	54.00	1.61	0.39	1.00	1.30	0.11	0.71
	SE(d)	50.06	55.45	52.75	2.28	0.55	1.42	1.84	0.16	1.00
	C.V.	8.96	8.92	8.94	10.48	11.65	11.07	4.75	13.42	9.09

Among two years 2015, 2016 and pooled analysis, pod mass was highest (Table 2) in no defoliation followed by 25%, 50% and 75 % levels of defoliation. The lowest pod mass per plant was recorded in severe (100%) defoliation. The moderate and severe defoliation treatments significantly reduced pod mass. The results show that assimilates produced by the leaves during the early stages of growth are used in the growth of stems and leaves, but the assimilates produced during the reproductive stage are used mainly for the growth of the pods. The pod number was positively correlated with stem weight. It appears that defoliation reduced pod number by depressing the growth of stems and this in turn reduced the number of flowering nodes. The results are in accordance with the findings of Enyi, 1975.

Certain results are obtained contrary to the present results. Partial reduction of photosynthetic surface from different branches caused enhancement of CO^2 uptake rate in the intact leaves on other branches. As most of the pods are produced from the main shoot and branches the changes in photosynthetic rates in the leaves of these two branches are reported (Sengupta *et al*., 1985) [8]. Complete defoliation except the main shoot caused greater increase in the rate of photosynthesis in the leaves of main shoot as compared to the plant with undefoliated main shoot plus two more branches. The enhancement in photosynthetic rate due to defoliation was greater on the intact leaves of branch-l than on the main shoot. Thus, defoliation of only main shoot caused higher effect on the rate of photosynthesis in the branch.

The results thus showed that the reduction in leaf area, root, shoot and pod mass was reduced either by complete defoliation or partial defoliation, which affected the photosynthetic rates of the leaves through the reduction in photosynthetic rate of all the branches. The adverse changes were arrested in no defoliation treatments of groundnut.

Table 2: Effect of defoliation studies on root mass (g/plant), number of pods per plant and pod mass (g) per plantground nut variety Kadiri- 6

		Root mass (g/plant)			Number of pods per plant			Pod mass (g) per plant		
		2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled
1	Control	11.00	10.66	10.83	23.67	21.67	22.67	4.30	5.03	4.67
2	25% Defoliation	5.13	4.63	4.88	13.67	12.67	13.17	2.10	1.98	2.04
3	50 % Defoliation	2.60	2.63	2.62	11.33	10.33	10.83	0.85	0.85	0.85
4	75% Defoliation	7.23	6.33	6.78	6.00	6.33	6.17	0.35	0.35	0.35
5	100 % Defoliation	0.64	0.62	0.63	3.33	3.33	3.33	0.10	0.10	0.10

	Mean	5.32	4.97	5.15	11.60	10.87	11.24	1.49	1.66	1.58
	C.D at 5%	8.20	0.70	4.45	4.37	3.60	3.99	0.39	1.18	0.79
	SE(m)	2.48	0.21	1.34	1.32	1.09	1.21	0.12	0.36	0.24
	SE(d)	3.50	0.30	1.90	1.87	1.54	1.70	0.17	0.50	0.33
	C.V.	8.62	3.73	6.18	19.72	14.27	17.00	13.71	6.88	10.29

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