International Journal of Agricultural Sciences
Volume 12 | Issue 1 | January, 2016 | 101-105 ■ e ISSN-0976-5670
DOI:10.15740/HAS/IJAS/12.1/101-105
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RESEARCH PAPER

Effect of foliar nutrition of urea and diammonium phosphate on seed yield and economics of sesame (*Sesamum indicum* L.) under rainfed situation

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Abstract : Field experiments were conducted on deep black soil of Mamurabad farm, Oilseed Research Station, Jalgaon (Maharashtra). Sesame cv. JLT-7 was sown during 2008,2009 and 2010 to find out suitable combination of soil and foliar application of urea and diammonium phosphate for seed yield maximization and remunerative treatments . Result revealed that, soil application of RDF + foliar spray of 2 per cent urea twice at flowering and pod formation stages significantly improved the yield attributes *viz*., number of capsules plant $^{-1}$ and number of seeds capsule^{-1}. These attributes contributed in producing significantly higher seed and oil yields and also proved more remunerative over soil application of RDF alone.

Key Words : Sesame, Foliar nutrition, Seed yield, Oil yield, Economics

View Point Article : Mahajan, H.S., Patil, Y.G., Hirwe, N.A., Patil, T.R. and Deshmukh, M.R. (2016). Effect of foliar nutrition of urea and diammonium phosphate on seed yield and economics of sesame (*Sesamum indicum* L.) under rainfed situation. *Internat. J. agric. Sci.*, **12** (1) : 101-105.

Article History : Received : 01.12.2015**; Revised :** 13.12.2015**; Accepted :** 25.12.2015

INTRODUCTION

Sesame is one of the most important *Kharif* oilseed crop cultivated in Maharashtra. It covers on area of 0.56 million ha with an annual production of 0.15 million tones and productivity of 268 kg ha^{-1}. (Damodaram and Hegde, 2010) which contributes 30.93 per cent and 23.44 per cent of national acreage and annual production of the nation. It is cultivated under rain fed conditions especially without giving attention on nutrient management. The predominant route for nutrients to enter plant tissue is via uptake through roots. The nutrients applied through chemical fertilizer may not be taken up properly by plant roots of crop plant due to poor water holding capacity of soil. Nitrogen being highly mobile in soil generally lost by many leaching take place under wet conditions of soil, while under dry conditions coupled with higher temperature, applied nitrogen is lost by volatilization. To avoid aforesaid losses of nitrogen, foliar application is an effective method for correcting its deficiency as suggested by Kalita *et al*. (1994) in pea. The applied quantity of phosphorus remains fixed in the soil due to its immobile nature. The efficiency of this applied

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phosphorus also can be improved by applying through foliar spray. Foliar application of nitrogen and / phosphorus in legumes indicated in considerable increase in seed yield (Jaiswal and Elandathi, 2007). Information pertaining to these aspects are not available on sesame crop for the region. Hence, the present investigation has been undertaken with the objective to find out the suitable combination of soil and foliar application of nutrients on yield and economics of the treatments.

MATERIAL AND METHODS

The field experiment were conducted at Mamurabad farm of Oilseed Research Station, Jalgaon during *Kharif* seasons of 2008, 2009 and 2010.The soil of experimental plot was clayey in texture moderately alkaline in reaction (pH 8.2) and analyzing in low organic carbon (0.43%.), available N (237.79 kg ha^{-1}) , high in available P (23.30 kg ha^{-1}) and in available K (345 kg ha^{-1}) content. The rainfall received was 413, 686.6 and 757.7 mm in 43, 34 and 43 rainy days, respectively during three cropping seasons. Nine treatments consist of different nutrient management as given in Table 2 were tested in Randomized Block Design with three replications on a well prepared seed bed. Sesame cv.JLT-7 (Tapi) was sown with 5 kg seed ha^{-1} in rows of 30 cm apart during first week of july in every year. An intra row plant spacing 10 cm was maintained by thinning. The recommended dose of 50 kg N ha^{-1} was given through urea as per treatment. Half of the total nitrogen was applied at the time of sowing and rest nitrogen was top dressed at 30 day old crop. All agronomic operation *viz.*, weed control, hoeing, thinning, plant protection measure and harvesting as well as post harvest operation were made uniformly under all treatments (Table 1). Various observation *viz.*, plant height, number of branches $plant^{-1}$, number of capsules $plant^{-1}$, number of seeds $capsule^{-1}$ and test wt. of seeds, finally seed yield were recorded at final stage. The oil yield of each treatment was determined on the basis of oil content present in seeds.The economic analysis of the treatments was also made on the basis of mean seed yield over the years. The experimental data were analyzed as per method suggested by Panse and Sukhatme (1957).

RESULTS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented under following heads :

Seed yield :

The sesame responded well to foliar application of urea and DAP integrated with RDF (50 kg N ha^{-1}) over application of RDF alone. The seed yield significantly varied due to different treatment during all the three years of experimentation and the trend of treatment was similar

Table 1: Package of practices followed for raising the sesame crop and other relevant information at Jalgaon (Maharashtra)

Recommended package of practices	Year / date of operations		
	2008	2009	2010
Improved variety	JLT-7	JLT-7	JLT-7
Planting geometry	30 cm x 10cm	30 cm x 10cm	30 cm x 10cm
Sowing time	04. 07.2008	06. 07.2009	08. 07.2010
Fertilizer dose (NPK kg ha^{-1})	50:00:00	50:00:00	50:00:00
Seed rate (kg/ha)	5 kg ha^{-1}	5 kg ha^{-1}	5 kg ha^{-1}
Seed treatment	Thiram@3g kg^{-1} seed	Captan @3g kg^{-1} seed	Thiram@3g kg^{-1} seed
Weeding (I^{st})	22.07.2008	10.08.2009	16.07.2010
(II^{nd})	04.08.2008	27.08.2009	13.08.2010
Thinning	26.07.2008	22.07.2009	22.07.2010
Hoeing	23.07.2008	13.08.2009	20.08.2010
Spraying of pesticide	16.08.2008	17.08.2009	20.08.2010
Urea and DAP 2% spray	25.08.2008	27.08.2009	29.08.2010
Date of harvesting	08.10.2008	29.09.2009	30.09.2010
Other information			
Rainfall (mm)	413 mm	687 mm	757.7mm
Number of rainy days	43	34	43

during the year. Therefore, pooled analysis of yield was affected by various nutrient management treatments were made. The soil application of RDF (50 kg N ha^{-1}) + foliar spray of 2 per cent urea twice at flowering and pod formation stage (T_4) produced maximum seed yield (723 kg ha^{-1}). Soil application of RDF (50 kg N ha^{-1}) + foliar spray of 2 per cent DAP at flowering and pod formation stage (T_5) was next to then but it was at par to soil application of RDF (50 kg N ha^{-1}) + foliar spray of 2 per cent urea once at flowering (T_2) in every year of experimentation (Table 4). Thus, it is clear that supplementation of foliar spray 2 per cent urea once at flowering stage or foliar spray of 2 per cent urea or DAP twice at flowering and pod formation stage produced significantly higher seed yield than 100 per cent RDF. The superiority in seed yield due to foliar spray of fertilizer supplemented with RDF over 100 per cent RDF alone attributed mainly due to effect of additional quantity of nitrogen and phosphorus fertilizer as per need by the crop. Thus, it could be concluded that the present recommended dose was not enough to meet the nutrient requirement of sesame under existing agro-climatic conditions. The foliar application of 2 per cent urea or DAP twice at flowering and pod formation stage along with 75 per cent RDF produced almost comparable seed yields to those produced by soil application of 100 per cent RDF only. The nutrient supply to crop was relatively lesser with application of 75 per cent RDF coupled with foliar application of nutrient once or twice than application of 100 per cent RDF to soil alone. Thus, it is evident that, foliar application of DAP or urea enhanced seed yield of crop more efficiently than application of full quantity to the soil, The superiority in higher yield with these treatment mainly attributed to the superiority in plant height ,capsules $plant^{-1}$ and seeds $capsule^{-1}$ with efficient utilization of nutrient by the plants, But branches $plant^{-1}$ and test wt. of seed did not cause marked influence on seed yields (Table 2, 3 and 4). Several worker have been emphasized for such improved nutrient use efficiency through foliar application of fertilizer in sesame under varying agro climatic conditions (Mishra 2010 and Anonymous, 2010).

Oil yield :

Oil yields are mainly governed by seed yield as well as oil content of seed under different treatments. Unlike seed yield under various treatment oil yield also varied differently due to them (Table 5). The oil content of seeds

Table 2: Effect of foliar nutrition of urea and diammonium phosphate on the ancillary and yield contributing character of sesame

Treatments	Plant height (cm)				No. of branches per plant				No. of capsules per plant			
	2008	2009	2010	Mean	2008	2009	2010	Mean	2008	2009	2010	Mean
T_1.RDF (Soil application)	126	128	127	127	3.2	3.6	3.4	3.4	44.48	44.76	44.58	44.60
T_2. T_1 + one foliar spray of 2% urea at flowering	129	131	132	131	3.5	3.8	3.6	3.6	46.00	46.28	46.10	46.12
T_3 . T_1 + one foliar spray of 2% DAP at flowering	126	130	128	128	3.4	3.7	3.5	3.5	45.10	45.38	45.18	45.22
T_4 – T_1 + two foliar spray of 2% urea at flowering and pod formation stage	131	135	133	133	4.0	4.4	4.2	4.2	47.06	47.34	47.16	47.18
T_5 - T_1 + two foliar spray of 2% DAP at flowering and pod formation stage	129	134	132	132	3.9	4.2	4.0	4.0	47.00	47.28	46.90	47.06
T_6 -75% RDF+One foliar spray of 2% urea at flowering	130	133	131	131	3.6	3.9	3.8	3.7	44.14	44.40	44.10	44.21
T_7 -75% RDF+One foliar spray of 2% DAP at flowering	128	131	129	129	3.5	3.8	3.7	3.6	44.98	45.26	45.02	45.08
T_8 -75% RDF+ two foliar spray of 2% urea at flowering and pod formation stage	131	132	129	131	3.8	4.2	3.9	3.9	43.80	44.08	43.90	43.92
T_9 -75% RDF+ two foliar spray of 2% DAP at flowering and pod formation stage	128	132	130	130	3.5	4.3	3.7	3.8	44.66	44.94	44.70	44.76
S.E. $\pm$	5.00	4.50	4.23	4.20	0.41	0.44	0.42	0.43	0.22	1.24	1.27	1.23
C.D. (P=0.05)	14.00	13.20	12.69	12.60	NS	NS	NS	NS	3.64	3.68	3.80	3.66

NS=Non-significant

Table 3 : Effect of foliar nutrition of urea and diammonium phosphate on the ancillary and yield contributing character of sesame

Treatments	No. of seeds per capsules				Test wt. (g)			
	2008	2009	2010	Mean	2008	2009	2010	Mean
T_1-RDF (Soil application)	22.15	20.60	22.40	21.71	2.83	2.70	2.87	2.80
T_2- T_1 + one foliar spray of 2% urea at flowering	21.47	19.92	21.72	21.03	2.82	2.69	2.86	2.79
T_3 - T_1 + one foliar spray of 2% DAP at flowering	20.29	22.09	21.75	21.37	2.83	2.70	2.88	2.80
T_4 – T_1 + two foliar spray of 2% urea at flowering and pod formation stage	22.26	20.71	22.51	21.82	2.84	2.71	2.88	2.81
T_5 - T_1 + two foliar spray of 2% DAP at flowering and pod formation stage	22.20	20.60	22.40	21.73	2.83	2.70	2.88	2.80
T_6 -75% RDF+ one foliar spray of 2% urea at flowering	21.59	20.04	21.84	21.15	2.77	2.64	2.81	2.74
T_7 -75% RDF+one foliar spray of 2% DAP at flowering	21.63	20.08	21.88	21.19	2.76	2.63	2.80	2.73
T_8 -75% RDF+ two foliar spray of 2% urea at flowering and pod formation stage	19.94	21.74	20.86	20.86	2.77	2.64	2.81	2.74
T_9 -75% RDF+ two foliar spray of 2% DAP at flowering and pod formation stage	21.60	19.95	21.75	21.06	2.78	2.65	2.82	2.75
S.E. $\pm$	0.14	0.13	0.15	0.12	0.5	0.4	0.6	0.4
C.D. (P=0.05)	0.40	0.37	0.43	0.34	NS	NS	NS	NS

NS=Non-significant

Table 4 : Effect of foliar nutrition of urea and diammonium phosphate on seed yield and economics of sesame

Treatments	Seed yield (kg/ha)				Economics		
	2008	2009	2010	Mean	GMR	NMR	B:C
T_1-RDF (Soil application)	460	685	573	573	31515	15758	1.99
T_2- T_1 + one foliar spray of 2% urea at flowering	542	782	655	660	36300	19182	2.12
T_3 - T_1 + one foliar spray of 2% DAP at flowering	521	732	652	635	34925	17847	2.04
T_4 – T_1 +two foliar spray of 2% urea at flowering and pod formation stage	597	863	708	723	39765	21841	2.21
T_5 - T_1 + two foliar spray of 2% DAP at flowering and pod formation stage	573	834	687	698	38390	20465	2.14
T_6 -75% RDF+one foliar spray of 2% urea at flowering	496	718	617	610	33550	16612	1.98
T_7 -75% RDF+ one foliar spray of 2% DAP at flowering	487	685	576	580	31900	15274	1.91
T_8 -75% RDF+ two foliar spray of 2% urea at flowering and pod formation stage	559	757	653	656	36080	18549	2.05
T_9 -75% RDF+ two foliar spray of 2% DAP at flowering and pod formation stage	507	704	606	606	33330	16048	1.92
S.E. $\pm$	45.51	45.28	37.94	23.34	1347	1011	0.055
C.D. (P=0.05)	135.15	134.41	112.67	65.68	3791	2846	0.111

- Economic analysis on mean yield basis (for 2008, 2009 and 2010), Sale price of sesame Rs. 55 per kg

Table 5 : Effect of foliar nutrition of urea and diammonium phosphate on oil content and oil yield of sesame

Treatments	Oil content (%)				Oil yield (kg/ha)			
	2008	2009	2010	Mean	2008	2009	2010	Mean
T_1-RDF (Soil application)	48.67	50.42	49.12	49.40	224	345	281	283
T_2- T_1 + one foliar spray of 2% urea at flowering	48.92	50.67	49.37	49.65	265	396	323	328
T_3 - T_1 + one foliar spray of 2% DAP at flowering	48.85	50.60	49.30	49.58	245	370	321	315
T_4 – T_1 +two foliar spray of 2% urea at flowering and pod formation stage	48.96	50.71	49.31	49.66	292	438	349	359
T_5 - T_1 + two foliar spray of 2% DAP at flowering and pod formation stage	48.74	50.49	49.19	49.47	279	421	338	345
T_6 -75% RDF+ one foliar spray of 2% urea at flowering	49.05	50.80	49.50	49.72	243	365	305	303
T_7 -75% RDF+ one foliar spray of 2% DAP at flowering	48.72	50.47	49.17	48.45	237	346	283	287
T_8 -75% RDF+ two foliar spray of 2% urea at flowering and pod formation stage	49.22	50.97	49.67	48.37	275	386	324	317
T_9 -75% RDF+ two foliar spray of 2% DAP at flowering and pod formation stage	49.08	50.83	49.53	48.23	249	358	300	292
S.E. ±	0.51	0.53	0.52	0.52	5.3	6.2	5.5	5.7
C.D. (P=0.05)	NS	NS	NS	NS	15.9	18.6	16.5	17.0

NS = Non - significant

did not differ due to different treatment, hence, seed yield alone attributed to oil yield. Consequently T_4 topped in oil yield also among all treatments closely followed by T_5 during every years of experimentation. The treatment T_2 was next to them. The treatments associated with application of urea and DAP either once or twice produce lower seed yield, hence they produced the minimum oil yields among all treatments. These finding are also supported by Mishra 2010 in sesame crop for the study.

Economics :

Soil application of RDF+ foliar application of urea 2 per cent twice at flowering and pod formation stage (T_4) led to record the highest gross monetary return, net monetary return and B:C ratio of Rs. 39765 ha^{-1}, Rs. 21841 ha^{-1} and 2.21, respectively followed by RDF + foliar application of 2 per cent DAP twice at flowering and pod formation stage (T_5) with gross monetary return of Rs. 38390 ha^{-1}, net monetary return of Rs. 20465 ha^{-1} and B:C ratio of 2.14. For soil application of RDF+ foliar application of 2 per cent urea once at flowering stage registering gross monetary return, net monetary return and B:C ratio value of Rs. 36300 ha^{-1}, Rs. 19182 ha^{-1} and 2.12, respectively (Table 4). Remaining treatment being less seed yielder fetched lesser gross monetary return, net monetary return and B:C ratio values (Mishra, 2010 and Anonymous, 2010).

From the results of three years of experimentation, for sesame yield maximisation soil application of recommended dose of fertilizer + foliar application of 2 per cent urea twice (at flowering and pod formation stage) is recommended for assured rainfall zone of North Maharashtra.

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