EFFECT OF NITROPHOS FERTILIZER ON THE GROWTH AND YIELD OF *NIGELLA SATIVA*

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ABSTRACT

Research on the medicinal plants was started by the researchers in the last century in order to allocate different valuable alternative resources to the increasing demands of population especially to those communities totally dependable on forests and other non renewable natural resources. *Nigella sativa* is a renowned medicinal herb of the world of herbaceous plants because of its multipurpose uses in different disease treatments. The study was conducted to increase the production of *Nigella sativa* by applying the NP fertilizer. This study was carried with objective to find the optimum doze of NP fertilizer for the growth and maximum yield of *Nigella sativa* and also to give farmer an easy way to get maximum benefit of his land resources during the rabbi season as compared to the other crops like maize. The study revealed that *Nigella sativa* shows maximum yield on the application of 275kg/ha of NP fertilizer in the region having similar edaphic, topographic and climatic conditions as in Peshawar.

INTRODUCTION

Poverty is not necessarily the want of money or cash in hand. In a wider sense, it is the lack of option, whether it is the non availability of fertilizer for crop cultivation or pesticides for crop protection, medicinal remedies for family welfare, safe contraceptives for regulating family size, fuel or firewood for cooking, timber for furniture, dwelling or the availability of appropriate technology for restoring wastelands, absence of income generation and employment opportunities. *Nigella sativa* can be ideally grown in any good garden soil in a sunny position. Its growth is ideal in a light soil located in warm position. By nature it is a greedy plant, inhibiting the growth of nearby plants, especially the legumes. This herbaceous species is often cultivated, especially in western Asia and India, for its edible seed. The seed is aromatic having a nutmeg scent. This plant can be commonly found in or near waste places, arable land and waysides. This plant is most commonly known for its edible seed and seed oil. Seed of Nigella sativa has been traditionally used in the middle and Far East countries for centuries to treat ailments including bronchial asthma and bronchitis, rheumatism and related inflammatory diseases, to increase milk production in nursing mothers, to treat digestive disturbances, to support the body's immune system, and to fight parasitic infestation. Its oil has been used to treat skin conditions. The number of uses of black seed has earned for this, the Arabic title Habbat-ul-Barakah, “meaning the seed of blessing”. The first written reference to Black cumin is thought to be in the Book of Isaiah in the Old Testament where the harvesting/cutting of this plant and wheat is contrasted (Isaiah 28: 25, 27). The history of Black cumin *(Nigella sativa)* of family Ranunculaceae is not very well known but with the help of some references it was believed that this plant has been discovered in the Tutankhamen's tomb, implying that it played an important role in ancient Egyptian

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practices and the items used by the king were carefully selected to assist him in the afterlife. Easton's bible dictionary uses the 'Hebrew' word for black cumin, without any doubt refers to the *Nigella sativa,* a small annual herb of the order Ranunculaceae which grows wild. This family is also known as the "buttercup family" or "crowfoot family". According to a database of the Royal Botanic Gardens, the family consists of 51 to 88 genera, counting about 1800 species. *Nigella sativa* seeds are a good source of oil and protein. Proximate analysis of the seeds showed a composition of 20.85% protein, 38.20% fat, 4.64% moisture, 4.37% ash, 7.94% crude fibre and 31.94% total carbohydrate. High yield is one of the ultimate objectives of any type of crop grower. There are various means through which yield can be increased. One of the important means of increasing the yield is the judicious application of fertilizers. This research work was initiated to study the effect of different doses of nitrophos fertilizer for increasing the seed yield of *Nigella sativa*.

REVIEW OF LITERATURE

The non availability of the Farm yard manure has forced the medicinal plants growers to resort to extensive use of fertilizers for normal growth and optimum yield of *Nigella sativa*. Nitrogen and phosphorus are the essential major nutrients for plants. These elements are present in the soil in various quantities. Each crop has its own fertilizer requirements and without the application of these elements, the successful production of any crop is not possible. In the following paper the research work conducted elsewhere on *Nigella sativa* is being reviewed.

Milne and Ali (1960) reported that black cumin could be successfully sown in different districts of Punjab from October to the middle of November. Malik and Khan (1965) conducted cultivation trials at Abbottabad and reported a seed yield of 360 kg/ha. Zaman and Khan (1968) conducted cultivation trials in Peshawar and reported a yield of 560 kg/ha under Peshawar climatic conditions. Ansari *et al* (1988) suggested the *Nigella sativa* is cultivated in Pakistan is used as a spice and for the treatment of various diseases. A saponin isolated from an ethanolic extract of the seeds. Nazir Hussain (2003) reported that *Nigella sativa* can be grown on saline soils and yield of 250 to 300 kg/ha can be obtained. Stefan Anderson (2005) worked on the floral costs in *Nigella sativa* compensatory responses to perianth removal and showed that the Plants subjected to early perianth removal produced 12.5% heavier seeds ($P<0.001$) and allocated 15.8% more biomass to seed production ($P<0.01$) than plants on which all perianths were left intact, whereas differences in flower production and total seed number were not significant. Perianth removal did not significantly affect the proportion of seeds that germinated (ca. 95% in both treatment groups; 2=0.04, P=0.84, data pooled across progeny families), but caused a shift toward earlier germination dates ($P<0.01$). Collapsing the germination dates into family means and including maternal seed mass as a covariate reduced the F value for treatment, but perianth removal continued to have a significant effect on germination date ($P<0.05$). Progeny seed number varied positively with seed mass (regression coefficient b=+0.62, $P<0.01$) and negatively with germination date (b= –2.45, $P<0.001$; multiple regression analysis on family means based on data pooled over treatments, N=135), but was not significantly affected by the presence or absence of perianth on the maternal parent, regardless of whether covariates were included or excluded. Ashraf M and Ali Q. Rah E. S (2005) examined the effect of applied

nitrogen on the growth and nutrient concentration of *Nigella sativa.* The soil nitrogen level, 90kg/ha, proved to be ineffective in promoting growth of Kalonji. Accumulation of nitrogen, potassium and phosphorus in both shoots and roots of Kalonji increased consistently with increase in soil nitrogen. However, this pattern of increase in the levels of 3 nutrients in plant tissues had a negative association with the growth of the crop, particularly at the supra-optimal nitrogen levels (60&90kgN/ha). Muslim. M and *et al* (2006) conducted the experimental studies on various agronomical characters of *Linum usitatissimum, Matricaria chamomilla, Foenicullum vulgare, Lallemantaia royleana* and *Nigella sativa* in different ecological zones of NWFP. Furthermore, he stated that *Nigella sativa* can be successfully grown at Mardan, Swabi, Charsadda, Bara and D.I. Khan. Bannayan. M, Ferdowsi *et al* (2008) showed the Yield and seed quality of *Plantago ovata* and *Nigella sativa* under different irrigation treatments and found no reduction in oil concentration for Black cumin or mucilage percentage for isabghol across all water deficit treatments. M. Özgüven, N. Sekerogluv (2009) worked on the agricultural practices for high yield and quality of *Nigella sativa* cultivated in turkey. The black cumin, an important source for a spice and in pharmaceutical industries, is one of the most cultivated medicinal and aromatic plants in Turkey. Different agricultural practices affect yield and quality in medicinal plant production. This study was carried out for two years to determine the effect of four doses of nitrogen (0, 30, 60 and 90 kg/ha) and three of phosphorus (0, 30 and 60kg/ha) on yield and quality of black cumin in arid and base conditions of Çukurova region of Turkey. In the present study, 60 kg/ha nitrogen and 60 kg/ha phosphorus fertilizations under the base field conditions gave the highest yield and quality of black cumin. The highest values for plant height, the number of branches, the number of capsules, seed yield, thousand-seed weight, essential oil content and seed fatty oil content were 100.1cm, 12.73 branches/plant, 22.2 capsules/plant, 1006 kg/ha, 2.35g, 0.40% and 39.0%, respectively. Martin Scholza *et al.* (2009) worked on Methyl jasmonate induced accumulation of kalopanaxsaponin-I in *Nigella sativa* in which Hydroponically cultivated *Nigella sativa* plants treated with methyl jasmonate (MeJA) showed a twelve-fold increase in levels of the monodesmosidic triterpene saponins-hederin and kalopanaxsaponin I (KsI) in the leaves. We will demonstrate that these two saponins accounted for approximately 10% of the dry plant matter, of which 93% was KsI and 7% hederin. To address the molecular basis of saponin induction by MeJA, we cloned and characterized the amyrin synthase gene (Ns-AS1). Abdalbasit Adam Marioda *et al* (2009) worked on the Antioxidant activity and phenolic content of phenolic rich fractions obtained from black cumin seedcake and showed that the antioxidant activities of crude methanolic extract (CME) and its fractions using ethyl acetate (EAF), hexane (HF) and water (WF) of black cumin seedcake were investigated. DPPH radical scavenging activity, carotene-linoleate bleaching, and inhibition of corn oil oxidation were used to evaluate the antioxidant capacity. The total phenolics were found to be 78.8, 27.8, 32.1 and 12.1mg gallic acid equivalents (GAE)/g in EAF, CME, WF and HF, respectively. The CME and EAF exhibited the highest DPPH followed by WF and HF. The extract/fractions showed high effect on reducing the oxidation of carotene. The effect of extract/fractions on the oxidative stability of corn oil at 70 °C was tested in the dark and compared with butylated hydroxyanisole (BHA). The oil peroxide and anisidine values were generally lower with addition of PRFs in comparison to a control. The predominant phenolic compounds identified by HPLC-DAD in CME and WF of black cumin seedcake were hydroxybenzoic, syringic and p-cumaric acids.

MATERIAL AND METHODS

The present study was carried out at the Medicinal Plants Farm, Pakistan Forest Institute, Peshawar during 2008-09 on the material was comprised of one cultivar of *Nigella sativa*. The soil of the experimental field was silty clay loam. The experimental area was prepared by ploughing the soil and all the clods were broken. Well rotten farm yard manure was applied at the rate of twenty cart load/ha before ploughing. The manure was mixed into the soil thoroughly. There was no crop before the experiment was started. Lay out of the experiment was done according to the Randomized Complete Block Design with four replications and four treatments. The plot size for each treatment was $48m^2$ and the total area was four kanals. The fertilizer treatment was nitrophos fertilizer i.e., 0, 150, 275 and 300kg/ha respectively. *Nigella sativa* seed was sown in November, 2009 in lines with row to row distance of 30cm. seed rate was kept 1kg/kanal. Just after the sowing, irrigation was given after a week and subsequent irrigation were given at an interval of one week or as required by the plants. Irrigation was done in such a way that the water was not allowed to go to the other plots. First dose of NP fertilizer was broadcast to each plot just before the sowing and the second dose of fertilizer was applied before flowering. Four to five weedings were performed during the experiment. The following agronomical data was recorded during the experiment:

- Number of branches/plant
- Number of pods/plant
- Number of seeds/pod
- Date of germination
- Date of flowering
- Date of seed maturity

Crop was harvested and the yield was recorded according to the layout plan.

RESULTS AND DISCUSSION

Seed was sown in lines in 1^{st} week of November 2008 in RCB design. When seedlings were of 3-4cm in height, thinning was done manually to ensure sufficient space for plant growth. Nitrophos (Nitrogen 70%, Phosphorus 30%) first application of fertilizer was given with urea and FYM during soil preparation. second dose of the fertilizer was given at the germination of seedlings. third dose of the fertilizer was made available at the flowering of plant and the last one was applied at the time of seed maturity. 1^{st} irrigation was done immediately after the sowing and then on the following times i.e., 4th week of November 2008 2nd week of January 2009. 3rd week of December 2008 1st week of February 2009. 4th week of February 2009 No irrigation was given in March and April due to rain. In May 2009 single irrigation was given in the 3^{rd} week. Hoeing was done o remove the weeds and other unnecessary plants from the crop. It was done at the specific times and the plants which were removed at each cleaning are given in Table 5. The crop was harvested in the 2nd week of June 2009 and left for drying in open air. Results revealed that *Nigella sativa* crop is greatly affected in yield and all its agronomic parameters by the application of NP fertilizer.

Yield

The yield of the crop significantly showed the positive responses to the application of NP fertilizer. As the doze concentration was increased the yield with all its parameters was increased until the optimum doze was determined that was at 275 kg/ha of NP fertilizer Nigella sativa has maximum yield of 895 kg/ha in R1 and mean yield in four plots was recorded to be 880 kg/ha. Further increasing of the doze concentration decreased the yield which means that the yield increased until the doze reached 275kg/ha. The minimum yield was recorded to be in control that was 622 kg/ha in R1 and with the mean yield of the four control plots was 564.5 kg/ha per plot, is given as under:

Table 1. Yield of *Nigella sativa* at Peshawar during Oct 2008-May 2009

Fertilizer doze (kg/ha)	R1	R2	R3	R4	Mean
0	622	634	635	367	2258
150	720	697	760	753	2931
275	888	895	845	892	3520
300	893	860	756	761	3271
Total	3123	3086	2996	2773	11979
LSD	60.95				
SE	27				
CV %	89690.27				

The Plant Height

The height of the crop was recorded at the final harvesting and the mean height taken is given in Table 3. The results showed that the fertilizer application significantly affected the plant height. Plant height was maximum that is 83.82 cm in 275 kg/ha application whereas was the lowest in control that was 58.42 cm. and also the mean when taken was higher from all in 275 kg/ha doze. The height results were significant at 0.01 Probability level. The results from the height were identical to those of N. Sultan 1985, Haq and Jabeen 1980 and Haq and M. Bibi 1987 which says that plant height increases with the increase in Nitrogen level. The data is given as under:

Table 2. Variation in Height (cm) in *Nigella sativa* at Peshawar during 2008-2009

Fertilizer doze (kg/ha)	R1	R2	R3	R4	Mean
0	58.42	66.04	60.96	63.5	248.92
150	66.04	73.66	68.58	71.12	279.4
275	76.2	81.28	73.66	83.82	314.96
300	68.58	71.12	66.04	73.66	279.4
Total	269.24	292.1	269.24	292.1	1122.68
LSD	0.683				
SE	0.30				
CV (%)	124.88				

Number of Branches

The number of Braches is an important parameter of the plant for the analysis of yield after height. The number of branches was increasing on the application of fertilizer but after 275 kg/ha that is at 300 kg/ha the parameter decreased as in Table 4. Minimum number of branches was in control that was 5 whereas the highest were recorded at 275 kg/ha doze that was 11 in number. The total number of branches were 38 at 275 kg/ha and data is given as under:

Table 3. Number of Branches in *Nigella sativa* at Peshawar during 2008-09

Fertilizer doze(kg/ha)	R1	R2	R3	R4	Total	Probability (%)
0	6	5	6	6	23	0.01
150	7	6	7	6	36	
275	11	8	9	10	38	
300	7	7	8	8	30	
Total	31	26	30	30	117	
LSD	.537					
S.E	0238					
CV (%)	8.556					
T Inverse	2.62					

Some other parameters were also observed which showed significant increase in their respective growth on the application of the fertilizer up to a certain doze. These are given on next page:

Table 4. Rainfall during the experimental span

S. No	Month	Rainfall (mm)	Dates on which Rain occurred and amount in (mm)
1	December 2008	11	19 (1.4 mm) and 20 (9mm)
2	January 2009	28	3(8mm), 18(6mm), 28(14mm)
3	February 2009	34	5(4mm), 12(10mm), 13(20mm)
4	March 2009	57	4(8mm), 19(1mm), 21(13mm), 24(17mm), 25(9mm), 29(9mm)
5	April 2009	94	6(18mm), 7(8mm), 8(14mm), 9(15mm), 14(17mm), 15(22mm)
6	May 2009	35	3(5.3mm), 4(4mm), 5(30mm), 19(2mm), 20(1mm)
Total	6 Months	259	The rainfall rate increased as the Time passed

Hoeing date and weeds removed

Hoeing	Date of Hoeing	Weeds Removed
1st	4th December 2008	Convulvolus arvensis and Fumaria indica
2nd	5th-8th January 2009	Medicago spp and Grasses
3rd	19th February 2009	Chenopodium album, C. murale and Medicago spp
4th	10th March 2009	Asphodellus tentifouis, Avena fatua, Phalaris minor and Many other Grasses.

Comparison of different parameters between control and other parameters are discussed as under:

Control and Fertilizer dose of 150 kg/ha

The result comparison is shown in the following able that the most significant increase in fertilizer treatment is in number of pods that is 54% from the control, the height increase is 12% from the control, number of branches increase is 50% from the control which is also the significant figure and lastly the number of seeds increase is 15%. This means that as a whole the parameters increase and which is clear in the yield generated that is 732kg which is 30% higher from the control.

Comparison of parameters between Control and Nitrophos fertilizer dose of 150kg

S/No.	Characteristic	Control	At Fertilizer (150 kg/ha)	Remarks
1	Mean Yield	564 kg	732 kg	Increase by 30%
2	Mean Height	62.23	69.85	Increase by 12%
3	Mean Number of Branches	6	9	Increase by 50%
4	Mean Number of Pods	11	17	Increase by 54%
5	Mean Seed Number/Plant	105	120	Increase by 15%

Control and Fertilizer dose of 275kg/ha

The result comparison is shown in the Table 4.8 the most significant increase in fertilizer treatment is again in number of pods that is 81% from the control, the height increase is 16.71% from the control, number of branches increase is 50% from the control which is also the significant figure and lastly the number of seeds per plant increase is 24%. This means that as a whole the parameters increase in percentage more than that in fertilizer dose of 150 kg/ha and which is clear in the yield generated that is 880kg which is 56% higher from the control.

Comparison of parameters between Control and Nitrophos fertilizer dose of 275kg

S. No.	Parameters	Control	At Fertilizer (275 kg/ha)	Remarks
1	Mean Yield	564 kg	880 kg	Increase by 56%
2	Mean Height	62.23	78.74	Increase by 16.5%
3	Mean Number of Branches	6	9	Increase by 50%
4	Mean Number of Pods	11	20	Increase by 81%
5	Mean Seed Number/Plant	105	130	Increase by 24%

Control and Fertilizer dose of 300kg/ha

The result comparison is shown in the following table, the most significant increase in fertilizer treatment is in number of pods that is 45% from the control, the height increase is 12.24% from the control, number of branches increase is 33% from the control which is also the significant figure and lastly the number of seeds per plant

increase is 10%. This means that as a whole the parameters increase and which is clear in the yield generated that is 812 kg/ha which is 45% higher from the control but lower than that in fertilizer in 275kg/ha. So it is clear that the yield decreases when the fertilizer dose is further increased from 275kg/ha to 300kg/ha of NP fertilizer.

S. No.	Parameters	Control	At Fertilizer (300 kg/ha)	Remarks
1	Mean Yield	564 kg	812 kg	Increase by 45%
2	Mean Height	62.23	69.85	Increase by 12.2%
3	Mean Number of Branches	6	8	Increase by 33%
4	Mean Number of Pods	11	16	Increase by 45%
5	Mean Number of Seeds/Plant	105	116	Increase by 10%

Comparison of parameters between Control and Fertilizer 300kg dose

CONCLUSION

The above results showed that the *Nigella sativa* yield is increased with proportion to the control crop as the fertilizer dose was increased with keeping other treatments same as to the control. The optimum dose was determined as to be 275kg/ha of Nitrophos fertilizer to the crop and the yield decreased as the fertilizer dose was increased. Therefore, it is concluded that *Nigella sativa* when grown in well prepared soil and Nitrophos is applied to the crop in four different treatments i.e., Control, 150kg/ha, 275kg/ha and 300kg/ha by keeping all other factors the same for all the sampling units. The results showed that the crop yield was maximum when Nitrophos was applied @ 275kg/ha and this also verify the results achieved on *Nigella sativa* crop at PFI, Farm, Peshawar during 2008. The medicinal information about *Nigella sativa* is a lot, but information about its Agrotechnology is more essential to introduce this crop at community level. At present, it is being cultivated at Medicinal Plants Farm, PFI, Peshawar, Swabi and Mardan and the desirable results convinced that it should be introduced to other areas having climate similar to Peshawar region and is also cultivated in Noshehra on experimental basis. There is an immense hope for the success of this experiment at these sites because the layout, whole procedure and the fertilizer dose which is recommended, is 275kg/ha.

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