

Study of the effects of different levels of N and P fertilizers on fruit yield of Anise (*Pimpinella anisum*)

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Studien über die Effekte von 12 verschiedenen N- und P-Mineraldüngungskombinationen auf den Samenertrag von Anis (*Pimpinella anisum*)

1 Introduction

Anise is an annual spice with small elliptical or pear-shaped fruit, which belongs to umbelliferous family, which after grinding seems like as olive powder with sharp smell as Anthol and has a sweet taste (LIDIA et al., 1991; CHEVALLIER, 1996). The effective material (the essence) of anise consists of Anthol (60–80 %), Estragol (10 %) and some other materials such as Methyl chavicol, Anisiqu Acid, Fenchone etc. (CHEVALLIER, 1996; KHAN and ZAIDI, 1983; SAMSAM, 1995). Many reported medicine advantages of anise are stomach strengthen, anti-bloating (anti-meteorism), stomach ache soothing etc. Favorable growing of anise is so important to produce economic fruit yield, which could be affected by different ecological and genetical factors. Undoubtedly, successful production of this crop is related to plant specific traits such as fruit yield efficiency and applying appropriate agronomic practices during growing season. Common fertilizers are one of the most important

factors to achieve acceptable yield, certainly and applying them in appropriate quantities and qualities is one of the opportunities to enhance economic yields and improve their essence quality. Fertilizers can affect the quantity and quality of products and by products of this crop by affecting the materials formation process; fruit yield and yield components and total effective materials concentration (NAJAFPOORNAVAL, 1995; YADAV, 1984). There are many reports on the effect of N and P fertilizers on anise production that are not consistent with each other in many cases. KHAN and ZAIDI (1983), applied N fertilizer in quantity of 0.23 gr/ plot in the soils envisaged by N deficit and showed that applied N increased anise fruit yield. YADAV (1984), also, in a study on the effects of N fertilizers on anise reported higher yield in higher N levels. In a study on the effects of N and P fertilizers on anise fruit yield, RANDHAWA and RAYCHAUDHURI (1992) showed that N didn't affect anise fruit yield, but it was increased in low P levels. This finding is consistent with other report by BAGHERZADEH (1999). As

Zusammenfassung

Um die Effekte von N- und P-Mineraldünger auf den Samenertrag von Anis zu erfassen, wurde ein Glaushausversuch mit 12 Versuchsvarianten (einer Kombination von 4 × 3 Düngungsstufen von N und P) durchgeführt. Die verwendeten Versuchsvarianten waren 3 Stickstoffstufen (N0, N0.077, < N0.15 gr/Gefäß als Harnstoff 46 %) und 4 Phosphorstufen (P0, P0.077, P0.15, P0.23 gr/Gefäß). Das faktorielle Versuchsschema wurde in 5, vollständig randomisierten, Wiederholungen angelegt.

Die Ergebnisse zeigen, dass sowohl die alleinigen und auch die kombinierten Effekte von N und P den Samenertrag signifikant beeinflussen. Auch die gesteigerten N-Stufen allein erhöhen den Samenertrag. Dieser Trend wurde in den P-Steigerungsstufen nicht gefunden, da die Samenerträge im Mittel der P-Varianten stagnieren. Schlussendlich zeigen unsere Versuche, dass steigende Gaben von Stickstoff den Samenertrag von Anis stärker erhöhen, als jene einer gesteigerten Phosphordüngung.

In dieser Studie konnte der höchste Samenertrag mit 13.92 gr/Gefäß in der Variante N0.15P0.15 erzielt werden, das waren um 75 % mehr als in der Kontrollvariante N0.P0. Unsere Schlussfolgerungen aus den Ergebnissen demonstrieren, dass spezielle Kombinationen von gesteigerten Düngergaben, im speziellen mit N, den Anbauern höhere Erträge bringen und die Wirtschaftlichkeit diese Kultur nachhaltig sichern.

Schlagerworte: Anis, *Pimpinella anisum*, Phosphor, Nitrogen, Fertilization.

Summary

In order to determine the effects of N and P fertilizers on anise fruit yield a greenhouse experiment which carried out 12 treatments (a combination of 4×3 levels of N and p, respectively) was conducted. The studied factors were N application in 3 levels (N0, N0.077, N0.15 gr/pot as urea 46 %) and P application in 4 levels (P0, P0.077, P0.15, P0.23 gr/pot as triple phosphate 46 %). The experiment design had a factorial arrangement with five completely randomized replications. The results indicated that the simple and combined effects of both N and P fertilizers on anise fruit yield were significant. Also increasing of applied nitrogen could result in increasing of fruit yield. This trend was not observed in studied P levels, as increasing of P levels was not accompanied by continuous increasing of fruit yield which demonstrated diminishing return of the response-input curve to P increment. Finally our results revealed that increasing of N could affect anise fruit yield more than P increment. In this study the highest value for fruit yield was related to N0.15P0.15 treatment (13.92 gr/pot), which caused 75 % increment in fruit yield in comparison with control treatment (N0P0). Our final results showed that increasing of studied fertilizers, especially N fertilizer, in a special range could be advisable to farmers to produce more yield and sustain their farms economically.

Key words: Anis, *Pimpinella anisum*, phosphor, nitrogen, fertilization.

it seems, the results of different literatures on the effects of N fertilizer on the anise fruit yield are contrariety. This study was aimed to investigate on the effect of different levels of N and P fertilizers on anise fruit yield to determine suitable rates of mentioned fertilizers.

2 Material and methods

This investigation was conducted in a greenhouse study. The used pots (with total capacity of 5 lit) were filled by a 2/2/1 (v/v/v) mixture of sand, clay and compost. The soil texture was loam (with EC = 1.95 ds/m, pH = 7.5, N = 0.06 %, P = 20 ppm and K = 310 ppm). The experiment design carried on 12 treatments as a factorial arrangement with five completely randomized replications. The studied factors were N application in 3 levels (N0, N0.77, and N0.15 gr/pot as urea 46 %) and P application in 4 levels (P0, P0.077, P0 15, P0. 23 gr/pot as triple phosphate 46 %). All treatments were kept in same conditions in respect to other practices during growing season and final-

ly fruits were removed and dried in open natural situations for weighting.

All collected data were subjected to an analysis of variance, and Duncan's multiple range tests were used to determine significant differences among treatment means at the 0.01 level.

3 Results and discussion

The results indicated that the simple and combined effects of both N and P fertilizers on anise fruit yield were significant (Table 1). The highest fruit yield (13.11 gr/pot) was related to the highest applied N level (N0.015 gr/pot), while the lowest one belonged to control treatment (8.75 gr/pot). Mean comparisons for mean fruit yield in each separate N and P levels showed significant difference of the highest N level in comparison with others (Table 2). Generally, our results indicated that increasing of applied nitrogen can result in increasing of fruit yield, as the N level of 0.077 gr/pot created intermediate values for fruit

Table 1: Analysis of variance on the effect of different N and P fertilizers levels on anise fruit yield

Table 1: Varianzanalyse der Effekte von verschiedenen N- und P-Mineraldüngergaben auf den Ertrag von Anis

S.V		df	SS	MS	FS
Treatment		11	218.56	19.87	582.333**
	N	2	190.19	95.095	2800.97**
	P	3	16.48	5.49	164.78**
	N×P	6	11.89	1.98	58.38
Error		48	11.63	0.034	–
Total		59	920.19	–	–

Table 2: Mean value comparisons for anise fruit yield by Duncan's multiple range test at 1 % of probability*
 Tabelle 2: Vergleich der Mittelwerte für den Samenertrag an Anis mittels Duncan-Test (P < 1 %)

Treatments	P0	P0.077	P0.15	P0.23	Mean
N0	7.94i	8.51h	9.24g	9.34g	8.75c
N0.077	9.96f	10.84e	11.65e	12.42e	11.22b
N0.15	12.98b	12.98b	13.92a	12.56c	13.11a
Mean	10.29c	10.78b	11.6a	11.44a	–

* The difference between the means with common letter is not different significantly.

yield in comparison with the highest and lowest rates. This trend was not observed in P levels, as increasing of P levels were not accompanied by continuous increasing of fruit yield. The highest mean fruit yield was obtained in P0.15 gr/pot (11.60 gr/pot).

Mean comparisons for mean fruit yield, also, showed non-significant difference between P0.15 and P0.23, but significant differences between P0.15 and lower applied levels. The lowest value for mean fruit yield was belonged to control treatment. These results demonstrated critical roles of N and P fertilizers to increase anise fruit yield and also showed critical thresholds to use P fertilizer that confirmed diminishing return of input-response curve for P fertilizer in anise. This can be interpreted by calculating of yield increase by fertilizer level increment. Our results indicated that obtained fruit yield in P0.15 and P0.23 resulted in 12 and 13 % increment in comparison with control treatment. On the other hand, mean comparisons for increment percentage of fruit yield in different P and N fertilizers showed highest values for N0.15, P0.15 and P0.23. Also the study of combined effects of N and P fertilizers (N and P fertilizer interactions) revealed that N0.15 beside of P0.15 as a treatment have been the best achieved value for fruit yield among all combined treatments (13.92 gr/pot). Statistical mean comparisons by Duncan's multiple range test for all studied treatments, also, showed that N0.15 × P0.15 have been the best treatment than other 11 treatments and its related mean yield has been statistically different than others. The lowest value for mean fruit yield also was belonged to control levels of both fertilizer types (P0N0). Obtained value for this case was 7.94 gr/pot. Calculated increments of fruit yield for different combination of N and P levels showed that increment percentage for fruit yield in comparison with control treatment varied between +75 to +7 % for N0.15P0.15 and N0P0.077 gr/pot, respectively. These findings proved that fertilizers are so important amendments to achieve high yields. Also, the comparison of increment percentages in fruit yield based on simple and combined effects of both used fertilizers showed that syner-

gistic effects of N and P fertilizers could be considerable. These results confirmed that the effect of N fertilizer on fruit yield was more than P effects. Generally, there are different causes to interpret better growth and attain more yields of plants under fertilized situation (favorable germination, better flowering, higher fecundity more appropriate fruit filling period etc). These results are consistent with other reports by YADAV (1984), who found applying of 40 and 60 kg N/ha can resulted in 19.5 and 80 % increment of yield, respectively. RANDHAWA and RAYCHAUDHURI (1992) in their experiments on the effects of different levels of N (10 to 40 kg/ha with 10 kg/ha intervals) and three P levels (0.15 and 30 kg/ha) on anise yield found that just application of P fertilizer in quantity of 15 kg/ha caused a little increase in fruit yield, but N levels had not any considerable effect in this regard. FAZECAS (1980) reported that the N and P fertilizers had positive effects on fruit yield, but had no effect on essence rate. KHAN and ZAIDI (1983) and YADAV (1984) also found similar results. Our final results showed that increasing of studied fertilizers, especially N fertilizer, in a special range could be advisable to farmers to produce more yield and sustain their farms economically.

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