EFFECT OF QAT LEAVES RESIDUE AND EXTRACT ON GERMINATION OF TOMATO SEEDS

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Kay words: Chemical effect, Qat, Tomato .

Abstract:

An experiment was conducted in 1993 in the Greenhouse Unit of the College of Agriculture, Sana'a University, to study the effect of qat leves residue and extract on tomato seed germination. Plastic pots 20 cm in diameter were filled with soil taken from the college field. Treatment was started directly at tomato seeding and included the control (no residues or extracts), residues (10 or 30 gms/pot) added either on top of the soil or mixed with it, and extracts (either 10 or 30 gms residues in 100 cm^3 water/pot).

In general the results showed that residues and extracts reduced percent germination of tomato seeds .The most significant reduction resulted when 30 gms of residues broadcasted on top of the soil, which was about 48%

compared to the control treatment. The results also showed that in general all treatments tended to delay germination. The most significant delay, which was about 7 days resulted from extracts made of 30 gms residues in 100 cm^3 water, compared to the control treatment.

It was concluded that this effect on germination may be due to the presence of allelochemicals in qat leaves, and hence it could he related to the phenomenon of allelopathy.

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Introduction:

Studies concerned with naturally occurring substances in plants which are also named secondary plant products have been related in the literature to the phenomenon of allelopathy. The term "allelopathy" have been applied to the phenomenon of biochemical interaction among plants (Einhellig, 1985). Implicit in this concept is the suggestion that compounds (allelochemicals) that are produced by a plant must escape into the environment and subsequently influence the growth and development of other plants.

Allelochemicals may affect members of the same species or plants of different species. The term "allelopathy" was coined by Molisch (1937) and it was defined by Muller (1969) as "the process in which a plant releases into the environment a chemical compound which inhibits the growth of another plant in the same or neighbouring habitat". In the current use, the term allelopathy refers to both inhibitory and stimulatory responses (Rice, 1984; Einhelling, 1985, and Putnam, 1985). However, most of the literature on this phenomenon have been directed to study the inhibitory or detrimental effects of higher plant of one species (the donor) on the germination, growth, or development of another (receptor) species (putnam and Duke, 1978; and Putnam, 1985).

Metabolic substances potentially involved in allelopathy are released by variety of means as described by Tukey (1968):

1. **Volatilization from foliage.**
2. **Leaching from foliage by rain, dew, or mist.**
3. **Litter accumulation.**
4. **Root exudatin.**

Allelochemicals vary from simple molecules such as ammonia to complex conjugated flavonoid such as phlorizin or the heterocyclic alkaloid caffeine (Zimdahl, 1987). Perhaps the most outstanding characteristic of these compounds is their diversity (Putnam and Duke, 1978; Rice, 1979, 1984; Einhell, 1985, Putnam, 1985, and Thomposon, 1985). They include a variety of chemicals wich belongs to different groups from which allelochimecal agent; alcohols, aldehydes, toxic gasses, fatty acids organic acids, nucleic acids, amino acids, aromatic acids, coumarins, quinones, lactones, flavonoids, tannins, alkaloids, terpenoids, steroids, phenols, polypeptides, and sulfides.

Although allelopathy is part of chemical ecology, several authors have pointed out that is has implications in agriculture (Putnam and Dake, 1987; Rice, 1979, 1984; Einhellig, 1985; Putnam, 1985; AND Zimdahl, 1987).

Qat or khat (Catha edulis Forssk.) belongs to the family Celastraceae. Considerable information about its botany, areas of cultivation, uses, composition, and effects especially on man are available. But as far as we know, no study on Qat effects on other plants especially crop plants have been published. Since qat is cultivated in large areas in Yemen and other countries, and as far as we know, no study was conducted on allopathy in qat. Therefore, this study was conducted. The main objective of the study is the look for future when qat plantations could be replaced by agricultural crops including vegetable crops. Tomato was chosen as the crop in this study because of its importance in Yemen and the world. Based on the knowledge of the phenomenon of allelopathy and allelochemicals and that they

have effects on seed germination in addition to the knowledge of the chemical composition of qat, it was decided to limit the current study on the effect of qat leaves residue and extracts on the germination of tomato seeds .

Material and methods:

The experiment was conducted in the Greenhouse Unit, Department of plant production, college of Agriculture Sana'a University, Sana'a, Yemen, Ten seeds of the tomato cv. "Napoli" were planted on the 28th of January, 1993 in plastic pots 20cm in diameter filled with soil taken from the field of vegetable crops, college of Agriculture. Table (1) shows the physical and chemical characteristics of the soil, and indicates that it is a sandy-loam soil. Leaves of qat cv. "Dhalae" was dried and grinded with an electric mill to provid the residues and extract. All treatments were applied directly at seeding, and they were as fellows:

1. Control (no residues or extracts was added).
2. Treatment one (TR1): 10 gms residues/ pot broadcasted on top of soil directly after seeding.
3. Treatment three (TR3): 10 gms residues/ pot mixed with the soil to about 5 cm directly before seeding.
4. (TR5): extracts (10 gms residues in 100 cm^3 water/ pot) added directly after seeding.
5. Treatment seven (TR7): 30 gms residues/ pot broadcasted on top of soil directly after seeding.
6. Treatment nine (TR9): extracts 30 gms residues/ pot mixed with the soil to a depth of about 5 cm direct before seeding.
7. Treatment eleven (TR11): extract (30 gms residues in 100 cm^3 water/ pot) added directly after seeding.

All pots were watered with a measured amount of water according to their daily requirements.

The experiment was designed as a completely randomized design with three replications (3 pots) per treatment. Tomato seedlings were counted daily as they emerged. The percent and rate of germination were calculated. The data was statistically analyzed by the computer according to the design used. Treatment means comparisons were made by LSD test at 5% level of probability.

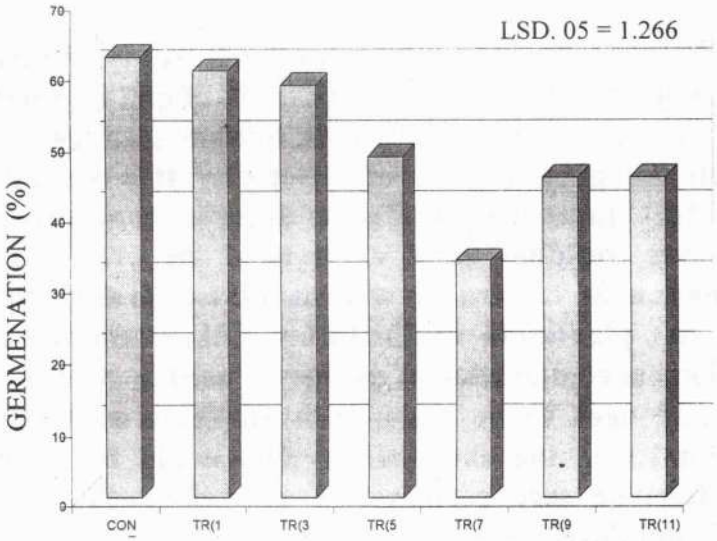
results and discussion:

In general, the results showed that qat leaves residues and their water extracts significantly reduced the germination percentage of the tomato seeds compared to the control (Fig. 1).The most severe and significant reduction was caused by TR (7) (30 gms residues/pot broadcasted on top of soil directly after seeding),with a reduction of about 48%, compared to the control treatment. The data in Fig. 2 shows that in general all treatments tended to delay the germination of tomato seeds as compared to the controls. The most significant delay resulted from TR (11) [extract (30 gms residues in 100 cm^3 water /pot) added directly after seeding], which delayed germination by about 7 days as compared to the control treatment.

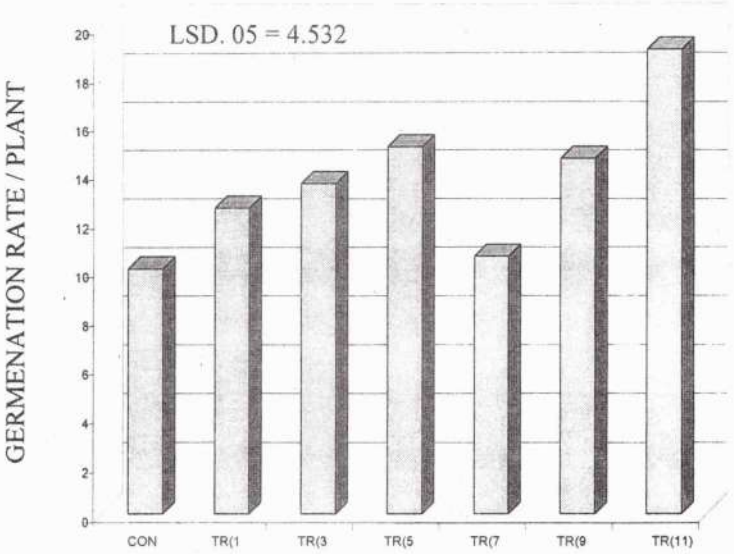
The results indicate clearly that qat leaves residues and their water extracts affects tomato seed germination. This effects may by due to some inhibitory allelochemicals contained in qat leaves. Studies on chemical composition of qat showed that it contains several alkaloids including

cathine, cathenine, cathedine, cathinone, and cathidolins, as well as amines such as d-norpseudo- ephedrine, tannin, and phenols (Bell, 1980; and FA0, 1980). It was mentioned that some of chemical compounds which plays a role in allelopathy and which are found in wild and cultivated plants, belongs to the alkaloid and phenol groups (Putnam and Duke, 1978, Rice,1979, 1984; Einhellig, 1985; Putman, 1985; and Thompson,1985). It was mentioned by Rice (1984), that several wild and cultivated plants have inhibitory effect on seed germination. Evenri (1949) gave a long list of species that have been known to produce inhibition of seed germination. However qat was not listed by either Evenari (1949) or Rice (1984). Furthermore' Evenari (1949) mentioned that germination inhibitors could be released from the different plant parts including leaves. Tannin, alkaloids, and phenols have been reported by Rice (1984) as germination inhibitors. Evenari (1949) emphasized strongly the importance of alkaloids as seed germination inhibitor, and mentioned the compound "ephedrine" as one of the alkaloids inhibitor of seed germination. As we mentioned earlier the compound d-norpseud- ephedrine (related to ephedrine) is found in qat. Hence, one could conclude that this compound as well as other compounds may have played a role in the inhibition of tomato seed germination. Therefore, qat leaves could be a source of allelochemicals that could inhibit seed germination in tomato as well as other plants.

It could be concluded from this study and from the knowledge of the chemical composition of qat, that qat could have its effect in inhibition of tomato seed germination through the phenomenon of allelopathy. It is recommended to conduct studies on the effect of different concentrations of qat leaves residues and extracts of the cv. (Dhalae) on germination of tomato as well as othe crop seeds that may rplace qat plantation in the future. Other studies including the chemical composition of qat leaves used in studies such as this study need to be done, with emphasis on determining and identifying the chemical (s) that could be involved in such effect on seed germination as well as other aspects of growth and development .



(FIG.1) TRAEMENTS AT THE TIME OF SEEDING



(FIG.2) TREATMENTS AT THE TIME OF SEEDING

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تأثير بقايا وعصارة اوراق القات على انبات بذور الطماطم

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كلمات مفتاحية : قات، طماطم، تأثير كيماوي .

ملخص :

تم تنفيذ التجربة عام ١٩٩٣ في وحدة الزراعة المحمية بكلية الزراعة بجامعة صنعاء بهدف دراسة تأثير بقايا وعصارة اوراق القات على انبات بذور الطماطم . جرى تعبئة اصص بلاستيكية بقطر ٢٠سم بتربة مأخوذة من حقل الكلية وبدأت المعاملات مباشرة في مرحلة بذر المحصول . تضمنت المعاملات على معاملة الشاهد (بدون بقايا او عصارة اوراق)، ومعاملة البقايا (١٠ او ٣٠ جم/اصيص) مضافة اما على سطح التربة او مخلوطة بها، ومعاملة العصارة (اما ١٠ او ٣٠ جم بقايا في كل ١٠٠ سم^3 ماء/اصيص) .

اظهرت النتائج ان البقايا والعصارات المستخدمه قد أدت إلى تخفيض نسبة انبات بذور الطماطم، وقد تبين ان الانخفاض الاكثر معنوية نتج في حالة معاملة الـ (٣٠) جرام من البقايا المنثورة على سطح التربة حيث بلغ الانخفاض حوالي ٤٨% مقارنة بمعاملة الشاهد . كما بينت النتائج بشكل عام ان جميع المعاملات قد عملت على تأخير الانبات . وكان تأخير الانبات الاكثر معنوية حوالي سبعة ايام – قد نجم عن معاملة العصارات المستخلصة من ٢ جرام من بقايا الاوراق في ١٠٠ سم^3 من الماء، مقارنة بمعاملة الشاهد

يستنتج من ذلك ان التأثير على النمو ربما كان عائدا إلى وجود خاصية التضاد الكيماوي في اوراق القات وقد يكون لذلك التأثير ارتباك بالضغوط النمو التي تنجم عن اطلاق مواد سمية من قبل نبات ما تؤدي إلى الحد من نمو نبات آخر .