Iraqi Journal of Market Research and Consumer Protection
(2025) 17(3): 37-46
DOI:
Shakir & Abood

المجلة العراقية لبحوث السوق
وحماية المستهلك

ROLE OF NUMBER OF POLLINATION TIMES, POLLINATERS AND ORGANIC FERTILIZER IN LEAVES MINERAL CONTENT AND YIELD OF BARHI DATE PALM

Mohammed Abdulhameed Shakir [1*] **, *M, R. Abood*** [2]
1department of Hort. and Landscape, College of Agricultural Engineering Sciences, University of Baghdad, Baghdad, Iraq, mohammed.abdulhameed1105a@coagri.uobaghdad.edu.iq
2Professor PhD., department. of Hort. and Landscape, College of Agricultural Engineering Sciences, University of Baghdad, Baghdad, Iraq, moayad.rajab@coagri.uobaghdad.edu.iq

Received 15/ 11/ 2023, Accepted 18/ 2/ 2024, Published 31/ 12/ 2025

ABSTRACT

The experiment was carried out in 2023 season in one of date palm orchard of Barhi cultivar cultivated at Dawar palm station belong to Ministry of Agriculture / Horticultural Department, to study effect of two pollinator cultivar and decomposed organic fertilizer on yield and leaves mineral content of date palms of 7-year-old cultivar Barhi, as 54 are selected. A palm tree of uniform height and age, as far as possible, free of disease and insect infestations, Factors of study experiment included addition of two pollinator cultivar, Ghanaami Akhdar (P_1), and local cultivar (P_2), while pollinations number was three times; once (N_1), Two pollinations (2 days after first pollination) (N_2) and pollination three times (3 days after first and 3 days after second) (N_3), As for decomposed organic fertilizer (sheep manure), they were added in three levels (0, 20, and 40 kg.date^{-1}), which are denoted by symbols M_0, M_1, and M_2, respectively. The experimental results showed that pollinators did not significantly effect in leaf nitrogen, phosphor content and fruit weight while local cultivar pollinator (P_2), significantly increased in fruit weight of 11.79 g. Results also showed that pollinations number did not significantly effect in leaf nitrogen, phosphor content while pollination three times (N_3) gave the highest fruit weight of 11.88 g. Sheep manure application was significantly affect especially at 40 kg.date^{-1} (M_2) excelled in leaf nitrogen content of 1.946 %, leaf phosphor content of 0.440 % and fruit weight of 12.70g.

Keywords: date palm, pollination, pollinators, organic fertilizers, fruit yield

[*]**The article is taken from the doctoral thesis of the first researcher.**

المجلة العراقية لبحوث السوق وحماية المستهلك

Iraqi Journal of Market Research and Consumer Protection

Shakir & Abood

(2025) 17(3): 37-46

دور عدد مرات التلقيح والملقحات والتسميد العضوي في محتوى الأوراق من العناصر و حاصل نخيل التمر البرحي

محمد عبد الحميد شاكر [1] ***، مؤيد رجب عبود*** [2]

1 قسم البستنة وهندسة الحدائق، كلية علوم الهندسة الزراعية، جامعة بغداد، بغداد، العراق، mohammed.abdulhameed1105a@coagri.uobaghdad.edu.iq

2. الاستاذ الدكتور، قسم البستنة و هندسة الحدائق ، كلية علوم الهندسة الزراعية ، جامعة بغداد ، العراق، moayad.rajab@coagri.uobaghdad.edu.iq

الخلاصة

نفذت التجربة في موسم 2023 في أحد بساتين النخيل صنف برحي المزروعة في محطة نخيل الدوار التابعة لوزارة الزراعة/ دائرة البستنة، لدراسة تأثير صنف الملقح والسماد العضوي المتحلل في حاصل ونوعية الثمار لنخيل التمر صنف برحي المكثر نسيجياً وبعمر 10 سنوات، اذ يتم انتخاب 54 نخلة متجانسة الارتفاع والعمر قدر الامكان والخالية من الاصابات المرضية والحشرية لأجراء المعاملات عليها، وتقسم الى ثلاثة قطاعات في كل قطاع 18 نخلة. العامل الأول هو صنف الملقح بصنفين هما غنامي اخضر (P_1) والصنف المحلي (P_2)، والعامل الثاني هو عدد مرات التلقيح وكانت التلقيح لمرة واحدة (N_1) والتلقيح مرتان (بعد 2 ايام من التلقيح الأول) (N_2) والتلقيح ثلاث مرات (بعد 3 ايام من الأولى و بعد 3 أيام من الثانية) (N_3) ، اما العامل الثالث هو اضافة السماد العضوي المتحلل (مخلفات الأغنام) وكان بدون اضافة (M_0) واضافه 20 كغم .نخلة (M_1) اضافه 40 كغم.نخلة (M_2) . أظهرت نتائج الدراسة ان الملقحات لم تؤثر معنوياً في محتوى الأوراق من النتروجين و الفسفور لكن الملقح المحلي (P_2) اثر معنوياً في وزن الثمرة اذ بلغت 11.79 غم. اشارت النتائج ايضاً ان عدد مرات التلقيح لم يؤثر معنوياً في محتوى الأوراق من النتروجين و الفسفور بينما التلقيح ثلاث مرات (N_3) اثر معنوياً في وزن الثمرة اذ بلغت 11.88 غم. كما ان اضافة مخلفات الأغنام لاسيما المستوى 40 كغم.نخلة (M_2) اثر معنوياً و اعطى اعلى محتوى للأوراق من النتروجين بلغ 1.946 %، اعلى محتوى للأوراق من الفسفور بلغت 0.440 %، واعلى معدل لوزن الثمرة بلغ 12.70 غم .

الكلمات المفتاحية: نخيل التمر، التلقيح، الملقحات، السماد العضوي، حاصل الثمار.

INTRODUCTION

Date palm tree, which belongs to Arecaceae family and order, is one of the most significant and ancient fruit trees that humans have ever seen. It is found in subtropical areas. Four genera of Palme, which comprise 200 species and around 4000 species overall, are most significant in terms of their economic importance and their relevance to human life. Include Phoenix genus, which is home to twelve species, the most significant of which, in terms of nutrition and economy, is Dactylifera (**Ibrahim, 2014; Kareem & Al-Dahan, 2020**). According to recent indicates, Iraq has about 17,036,560 palm trees and produces about 639,315 tons. There are eight male date palm types and over 628 female variations in Iraq. Notably, Barhi cultivar is highly sought after by date consumers for its exceptional qualities (**PCBS, 2019**). Plant development and growth is controlled by several factors, Fertilization plays a crucial function in controlling plant growth and development as well as improving fruit features, which favorably impacts yield and farmer revenue. Several factors influence productivity improvement (**Al-Hadethi *et al.*, 2020; Al-Halfi & Al-Azzawi, 2022**). Studies have indicated that the characteristics of date palm fruits vary depending on the type of pollen grain used. Palm trees require adequate amounts of nutrients to be used in essential processes, such as improving the percentage of pollinated flowers and pollination efficiency. Consequently, while choosing pollinators, look for those that produce copious amounts of pollen with high vitality and efficiency during fertilization, as well as those that have a limited

impact on the features of the fruits resulting from significant issues that require treatment. Due to the enormous influence that pollen grains have on the features of date palm trees' seeds and fruits, it requires the same level of care for female date palm plants (**Ghaleb, 2008; Khierallah *et al.*, 2017**). Numerous studies conducted in different date palm and date production regions worldwide have demonstrated a clear effect of pollen source on fruit setting percentage. For example, some researchers have found that using pollen from different male varieties does not significantly affect the percentage of fruit setting for a given variety of female date palm, while other research has found statistically significant differences in fruit setting percentage according to different pollen sources used during pollination.(**Abdel Wahab & Homd, 2014**) found in their study on effect of pollination date palm and different pollens sources, four male cultivars were used (Asfar,Ghanamy red, Ressaisy and Aswad) in fruit set and crop quantity date palm C.V . Ashrassi in two sites and found that male Asfar pollens had a significant effect on fruit yield and fruit set. (**Mustafa *et al.*, 2014**) Also found differences in fruit set of female cultivar mothers when pollinating their fruits with five sources of pollen, where fruits pollinated with Nubaria pollen gave highest fruit set compared to Aswan pollen, which gave lowest percentage.

Organic fertilizers are not only more affordable and easily accessible in local markets, but they also improve the properties of soil by improving soil aeration, which promotes root spread and growth, as well as its role in increasing nutrient availability and increasing the various activities of microorganisms and their secretions, which increase plant resistance to drought conditions. Professionals in agriculture are well aware of the importance of organic matter and how it influences vegetative growth characteristics, fruit yield, and fruit quality when added to soil or sprayed on vegetative systems. In other words, organic matter provides nutrients to plants without endangering the environment (**Nardi *et al.*, 2016; Al-Hadethi, 2019**). There are many studies that indicated positive effect of organic fertilization on fruit trees leaf mineral content and fruits characteristics.(**Taha & Abood, 2018)** in a study, that included addition of both amino acids , organic fertilizer and seaweed extract at concentrations (3, 6) ml.L^{-1} , (1, 2) kg.tree $^{-1}$ and (4, 8) ml. L^{-1} respectively they found it significantly increased in leaves iron, nitrogen and phosphor content when addition this organic fertilizers in Barhi dates palm trees. (**Al-Marsoumi & Al-Hadethi, 2020)** Mentioned that humic acid and seaweeds extract spray with caused a significant increase in leaves nitrogen and phosphor compared to unsprayed seedlings from his study on Qalib Al-thor mango cultivars. Through an examination of their effects on fruit set, fruit weight, and leaf mineral content for date palm of Barhi cultivar, the study seeks to assess a few pollinators, number of pollination times, and use of organic fertilizer.

MATERIALS AND METHODS

The experiment was conducted in 2023 season in a date palm orchard of the Barhi cultivar at Dawar palm station, which is owned by Ministry of Agriculture / Horticultural Department. The purpose of this study was to determine impact of pollinator cultivar and

decomposed organic fertilizer on yield and mineral content of leaves of seven-year-old Barhi cultivar of date palms that receive drip irrigation, as 54 were chosen. When feasible, a palm tree should be same height and age and should not have any disease or insect infestations. Factors of study experiment included addition of two pollinator cultivar, Ghanaami Akhdar (P_1), and local cultivar (P_2), while pollinations number was three times; once (N_1), Two pollinations (2 days after first pollination) (N_2) and pollination three times (3 days after first and 3 days after second) (N_3), As for sheep manure, they were added in three levels (0, 20, and 40 kg.date^{-1}), as symbols M_0, M_1, and M_2, respectively. Treatments were replicated three times at factorial experiment in a RCBD; number of date palm trees used was 54 trees. The results of study were statistically analyzed and averages were compared according to (L.S.D) at 0.05 according to (**Elsahookie & Wuhaib, 1990**) Organic fertilizer will be added in December. The following parameters were determined in experimental season:

1. Leaf Nitrogen and Phophor Content: in 20-9-2023 samples of four pinnae were taken from middle part of each fronds and leaves were washed with tap water, rinsed with distilled water, and then dried at 70 c^0 until a constant weight, ground and digested according (**Chapman & Pratt, 1978**). Nitrogen was estimated by micro-kjeldahl method of (**A.O.A.C, 1980**). Phosphorus was estimate chromatic by using spectrophotometer by (**Estefan *et al.*, 2013**).
2. Fruit dry weight (%): calculated by dividing fruit dry weight / fruit fresh weight x 100.
3. Fruit weight (g): average fruit fresh weight was calculated by taking ten fruits randomly from each replication, and fruits were weighed using a sensitive balance.

RESULTS AND DISCUSSIONS

Effect of number of pollination times, pollinators and organic fertilizer on leaf nitrogen and phosphor content in date palm trees:

Data concerning effect of treatments on leaf nitrogen and phosphor content are listed in (Tables, 1 and 2). The data cleared that, number of pollination and pollinators did not significantly effect in leaf nitrogen and phosphor content. Sheep manure application was significantly effect in leaf nitrogen and phosphor content especially at 40 kg.date^{-1} (M_2) excelled in leaf nitrogen content of 1.946 % and leaf phosphor content of 0.440 %, while lower values of these traits was in M_0 treatment . Interactions between number of pollination and pollinators did not significantly effect in leaf nitrogen and phosphor content. Interactions between pollinators and sheep manure application significantly affected especially when interaction treatment (P_1M_2) and gave 1.951 % as leaf nitrogen content, while interaction treatment (P_2M_2) gave 0.457 % as leaf phosphor content. The interaction between organic fertilizer treatment (sheep manure) and pollination number especially interaction treatment (N_1M_2) as it gave highest leaf nitrogen content of 1.949 % and gave highest leaf phosphor content of 0.446 %. Triple interactions between study factors had a significant effect in these traits.

Table (1) Effect of number of pollination times, pollinators and organic fertilizer and their interaction on leaf nitrogen content (%) in date palm trees (season 2023).

Pollinator cultivar (P)	Pollination numbers (N)	Organic Manures (M)			P × N
		M_0	M_1	M_2	
P_1	N_1	1.517	1.739	1.955	1.737
	N_2	1.526	1.714	1.972	1.737
	N_3	1.531	1.758	1.927	1.739
P_2	N_1	1.523	1.717	1.943	1.728
	N_2	1.528	1.748	1.918	1.731
	N_3	1.519	1.724	1.961	1.735
L.S.D 0.05		0.076			N.S
P × M					P
P_1		1.525	1.737	1.951	1.738
P_2		1.523	1.730	1.941	1.731
L.S.D 0.05		0.044			N.S
N × M					N
N_1		1.520	1.728	1.949	1.732
N_2		1.527	1.731	1.945	1.734
N_3		1.525	1.741	1.944	1.737
L.S.D 0.05		0.054			N.S
M		1.524	1.733	1.946	
L.S.D 0.05		0.031			

These outcomes could be result of adding sheep manure, which modifies properties of soil by improving its aeration and water retention capacity, thereby facilitating spread and growth of roots. It also plays a role in increasing availability of nutrients, which increases their absorption and is reflected in concentration of those nutrients in leaves (**Jubeir & Ahmed, 2019; A-Mafrajee *et al.*, 2022**). These results are consistent with what he found (**Khalil, 2023**) on citrus species; found a significant increase in leaf phosphor and nitrogen content when adding organic fertilizers.

Table (2): Effect of number of pollination times, pollinators and organic fertilizer and their interaction on leaf phosphor content (%) in date palm trees (**season 2023**).

Pollinator cultivar (P)	Pollination numbers (N)	Organic Manures (M)			P × N
		M_0	M_1	M_2	
P_1	N_1	0.328	0.389	0.438	0.385
	N_2	0.341	0.397	0.414	0.384
	N_3	0.345	0.400	0.420	0.388
P_2	N_1	0.366	0.415	0.454	0.412
	N_2	0.357	0.405	0.454	0.405
	N_3	0.351	0.394	0.462	0.402
L.S.D 0.05		0.059			N.S
P × M					P
P_1		0.338	0.395	0.424	0.386
P_2		0.358	0.405	0.457	0.406
L.S.D 0.05		0.034			N.S
N × M					N
N_1		0.347	0.402	0.446	0.398
N_2		0.349	0.401	0.434	0.395
N_3		0.348	0.397	0.441	0.395
L.S.D 0.05		0.041			N.S
M		0.348	0.400	0.440	
L.S.D 0.05		0.024			

Effect of number of pollination times, pollinators and organic fertilizer on fruit dry weight and fruit weight in date palm trees:

Data concerning effect of treatments on fruit dry weight and fruit weight are listed in Tables (3 and 4). Data cleared that, number of pollinations especially twice (N_2), showed significant superiority in fruit dry weight of 78.64 % and pollination three times (3 days after first and 3 days after second) (N_3) gave the highest fruit weight of 11.88 g, while pollination one times (N_1) was lowest values of these traits. Tables (3 and 4) also shows that local cultivar pollinator (P_2), significantly increased in fruit dry weight of 77.84% and highest fruit weight of 11.79 g, while lower values of these traits was in P_1 pollinator. Also, addition of organic fertilizer had a significant effect on fruit dry weight percentage, where M_2 treatment was significantly superior to control treatment as it gave a percentage of 80.44%, while control treatment gave lowest rates for this characteristic and it was 67.62 %, there is also a significant effect on fruit weight, where M_2 treatment was significantly superior to control treatment as it gave a weight of 12.70 g, while control treatment gave lowest rates for this trait and it was 10.67 g. Interactions between pollinators and number of pollination significantly affected in

fruit dry weight and fruit weight especially interaction treatment (P_2N_2) and (P_2N_3) of 83.24 % and 12.03 g, respectively. Interactions between pollinators and sheep manure application significantly affected especially when interaction treatments (P_2M_0) and (P_2M_2) and gave 82.10 % as fruit dry weight and 13.20 as fruit weight, respectively. The interaction between pollination number and organic fertilizer treatment (sheep manure) especially interaction treatment (N_1M_2) as it gave highest fruit dry weight of 84.06 % and interaction treatment (N_3M_2) gave the highest fruit weight of 13.38 g. Triple interactions between study factors had a significant effect in fruit dry weight and fruit weight.

Table (3): Effect of number of pollination times, pollinators and organic fertilizer and their interaction on fruit dry weight (%) in date palm trees (**season 2023**).

Pollinator cultivar (P)	**Pollination numbers (N)**	**Organic Manures (M)**			**P × N**
		M_0	**M_1**	**M_2**	
P_1	N_1	51.66	78.00	84.00	71.22
	N_2	54.13	82.00	86.00	74.04
	N_3	53.60	77.15	72.33	67.69
P_2	N_1	80.40	52.00	84.12	72.17
	N_2	85.91	83.82	80.00	83.24
	N_3	80.00	78.07	76.21	78.09
L.S.D 0.05		9.48			5.47
P × M					P
P_1		53.13	79.05	80.78	70.99
P_2		82.10	71.30	80.11	77.84
L.S.D 0.05		5.47			3.16
N × M					N
N_1		66.03	65.00	84.06	71.70
N_2		70.02	82.91	83.00	78.64
N_3		66.80	77.61	74.27	72.89
L.S.D 0.05		6.70			3.87
M		67.62	75.17	80.44	
L.S.D 0.05		3.87			

Table (4): Effects of number of pollination times, pollinators and organic fertilizer and their interaction on fruit weight (g) in date palm trees (**season 2023**).

Pollinator cultivar (P)	**Pollination numbers (N)**	**Organic Manures (M)**			**P × N**
		M_0	**M_1**	**M_2**	
P_1	N_1	10.15	10.79	11.90	10.95
	N_2	10.36	10.91	11.59	10.95
	N_3	10.88	11.20	13.12	11.73
P_2	N_1	10.57	11.11	12.78	11.49
	N_2	11.00	11.35	13.19	11.85
	N_3	11.08	11.38	13.64	12.03
L.S.D 0.05		0.96			0.55

P × M				P
P_1	10.46	10.97	12.20	11.21
P_2	10.88	11.28	13.20	11.79
L.S.D 0.05	0.55			0.32
N × M				N
N_1	10.36	10.95	12.34	11.22
N_2	10.68	11.13	12.39	11.40
N_3	10.98	11.29	13.38	11.88
L.S.D 0.05	0.68			0.39
M	10.67	11.12	12.70	
L.S.D 0.05	0.39			

The results of tables (3 and 4) may be due to effect of sheep manure adding, which improve most soil characteristics, and increase absorption of water and nutrients, and improving absorption of elements, including nitrogen and phosphor tables (1 and 2), and increase of photosynthesis and formation of carbohydrates and proteins, which effect in fruit weight (**Shilan & Hama,2022).** These results are consistent with what he found (**Alghanim *et al.*, 2023**) they found a significant increase in apple fruit weight when adding or spraying with organic fertilizers.

CONCLUSIONS

Pollinations of date palm with different pollinator at different times had a positive effect on improving fruit characteristics. Also, adding organic fertilizer (Sheep manure) to soil planted with date palm produced positive effects by improving leaves mineral content and fruits characteristics.

REFERENCES

1. A.O.A.C. (1980). Official Methods of Analysis. 13th. Ed. Association of Official Analytical Chemists. Washington, D.C.
2. Abdel Wahab, N.I & Homd, A. Th. (2014). Effect of pollination date and pollens source on fruit and crop quantity of date palm set (Phoenix dactylifera.L) C.V Ashrassi in two sites. Diyala Journal of Agricultural Sciences. 6(2):49-59.
3. Alghanim, Faten S. R., Al-Hadethi, M. E. A & Yaviç , A.(2023). Response of Apple Trees Performance to Moringa Extract, Humic Acid, and Liquid Organic Fertilizers (Vit-Org). J. of Plant Production. 14 (6):313 – 317.
4. Al-Hadethi, M.E.A. (2019). Response of hawthorn transplants to biofertilizers and poultry manure. Iraqi Journal of Agricultural Sciences. 50(2):734- 740.
5. Al-Hadethi, Mustafa E.A., Taha, Fadia H &. Abbood, Shamil M. (2020). Effect of compost prepared from plant residues on olive transplants growth. International Journal of Agricultural and Statistical Sciences. 16 (Supplement 1): 1385-1389.

6. Al-Halfi, Dhyaa A. N & Al-Azzawi, Sinan S. J. (2022). Effect of organic fertilizer sourcrs and chemicl fertilization on some soil physicl traits and yield of summer squash (Cucurbta Pepo L.). Iraqi Journal of Market Research and Consumer Protection. 14(2): 74-81 .
7. Al-Mafrajee, Wameedh M. A & El-Rubaee, Faiz A. H. (2022). Effect of spraying organic emulsion (appetizer) and NANO NPK with urea on some growth characteristics of threesynthetic cultivars of maize. Iraqi Journal of Market Research and Consumer Protection. 14(1): 108-117 .
8. Al-Marsoumi, F.S & Al-Hadethi, M. E.A. (2020). Effect of humic acid and seaweed extract spray in leaf mineral content of mango seedlings. Plant Archives. 20 (1):827-830.
9. Central Organization for Statistics & Information Technology (PCBS). Ministry of Planning and Development Cooperation. Report production of date palm trees for the year 2019. Baghdad. Iraq.
10. Chapman, H. D. & Pratt, P. E. (1978). Methods of Analysis for Soils, Plants, and Waters. First Edition. Univ. of Calif., Div. Agric. Sci., Priced Pub., 4034.pp .
11. Estefan, G; R. Sommer & Ryan, J. (2013). Methods of soil, plants and water analysis, ICARDA, International for Agriculture Research in the dry areas, third edition. www.icarda.org.
12. Elsahookie, M. M. & Wuhaib, K.M. (1990). Design and Analysis of experiments. First Edition. Dar al hekma. Univ. Of Bagh. pp.488.
13. Ghaleb, H. H. A. (2008). Atlas of Date Palm Varieties in the United Arab Emirates. Zayed Center for Heritage and History. United Arab Emirates.
14. Ibrahim, A.O. (2014). Date palm. Agriculture, service, technical care, and manufacturing. Isa Cultural Center, Bahrain.
15. Jubeir, Sh. M. & Ahmed, W.A. (2019). Effect of Nano fertilizers and application methods on vegetative growth and yield of date palm. Iraqi Journal of Agricultural Sciences.50 (1):267-274 .
16. Kareem, A.A.A & Al-Dahan, M. R. A. (2020). Influence of some factor on somatic embryos induction and germination of date palm Barhi C.V by using cell suspension culture technique. Plant Archives. 20(Supplement 1): 1666-1670 .
17. Khalil, N.H. (2023). The effect of organic fertilization on leaf mineral content of three citrus species. IOP Conf. Ser.: Earth Environ. Sci. 1158 .042049.
18. Khierallah, H.S.M., Abood, M. R, & Al-Rawi, T. K. (2017). Sex identification of date palm by using DNA molecular markers. Iraqi Journal of Agricultural Sciences. 48(5):1197-1205.
19. Mustafa, E.A.M., Heiba, S.A.A., Saleh, M.M.S., Ashour, N.E., Mohamed, D. A. & Abd El-Migeed, M. M. M. (2014). effect of different Pollinizer sources on yield, fruitcharacteristics and phylogenetic relationships with Amhat cv. date palm (Phoenix dactylifera L.) In Egypt using RAPD markers. International Journal of Agricultural Researches. 9(7): 331-343.

20. Nardi, S., Pizzeghello, D., Schiavon, M. & Ertani. A. (2016). Plant biostimulants: physiological responses induced by protein hydrolyzed-based products and humic substances in plant metabolism. Scientia Agricola. 73(1):18-23 .
21. Shilan, H.S & Hama, S.H. (2022). Effect of NPK and organic fertilizers on yield and seed oil content of rapeseed (Brassica napus L.). Iraqi Journal of Agricultural Sciences .53(4):878- 889 .
22. Taha, F.H & Abood, M.R. (2018). Influence of organic fertilizer on date palm CV. Barhi 2. Leaves mineral content. Iraqi Journal of Agricultural Sciences. 49(3): 372-376.