

## OPTIMIZED POTENTIAL OF UTILIZATION EFFICIENCY AND PRODUCTIVITY IN WHEAT BY INTEGRATED CHEMICAL NITROGEN FERTILIZATION AND STIMULATIVE COMPOUNDS

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**ABSTRACT.** Foliar sprays application is an important crop management strategy, which could help to maximize yield and other beneficial substances. Therefore, a field experiment was conducted at Kafrelsheikh University research farm, Egypt, to study the effect of stimulating compounds (control, salicylic acid and ascobien) and nitrogen levels (0, 57.5, 115, 172.5 and 230 kg N ha<sup>-1</sup>) on yield and nitrogen utilization efficiency of wheat. Results indicated that spraying of ascobien and increasing nitrogen level had significant effect on yield traits. Interaction between stimulating compounds and nitrogen were achieved progressive increases in all yield traits, furthermore, the magnitude of increments was much more pronounced in response to salicylic acid and control treatments in both seasons. It was observed no statistically significant difference between 172.5 and 230 kg N ha<sup>-1</sup> in both seasons. A significant interactive effect were observed on grain N uptake, whole plant N uptake, nitrogen harvest index (NHI), nitrogen utilization efficiency (NU<sub>E</sub>) and nitrogen use efficiency (NUE) by using foliar spraying combined with N fertilizer. Grain N uptake and whole plant N uptake were closely correlated with nitrogen under stimulating compounds, whereas ascobien with 172.5 kg N ha<sup>-1</sup> was more effective than salicylic acid in both seasons. Interestingly, foliar spraying of ascobien and N level of 172.5 kg ha<sup>-1</sup> was the optimal and could be a useful to improve the efficiency of N-fertilizer and it can be saved 57.5 kg N ha<sup>-1</sup>. Consequently, could be the key to reduce the need for chemical fertilizers and decrease the cost of production.

**Keywords:** wheat; ascobien; salicylic acid; grain N uptake; nitrogen utilization efficiency.

## GROWTH AND YIELD PERFORMANCE OF MAIZE SEEDED IN LINE AND BROADCASTED TO VARYING DOSES OF NITROGEN

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**ABSTRACT.** Improving production through better agronomic management is continued to feed ever-increasing population. The objective of this study was to quantify the effect of N on maize seeded in line or broadcasted. Treatments included four level of urea nitrogen (N), i.e. 0, 60, 120 and 180 kg ha<sup>-1</sup> and two sowing techniques, i.e. drill sowing (improved) and broad cast (farmer practice). Improved method of sowing had improved yield and yield contributing parameters whereas emergence m<sup>-2</sup> and biological yield was higher in broadcast method of sowing. Increasing N application had increased biological yield, number of plants at harvest and grains ear<sup>-1</sup> linearly. Cobs per plant, grain yield, 1000 grains weight and harvest index showed sigmoid response to N application and was maximum at 120 kg N ha<sup>-1</sup>. Sowing of maize seed in line method and receiving 120 kg N ha<sup>-1</sup> had increased grain yield by 45% over broad cast method of sowing receiving the same dose of nitrogen. However, the farmer practices method had increased the forage (straw) when received higher amount of N, i.e. 180 kg N ha<sup>-1</sup>. Thus, it is concluded from the experiment that application of 120 kg N ha<sup>-1</sup> and seed sown in line had increased the yield and yielding parameters, compared to other treatments and

is, therefore, recommended for general cultivation of variety Azam in agro-climatic condition of Peshawar.

**Keywords:** agronomic management; maize production; nutrients; sowing methods.

## **ZEAMATIN-LIKE PROTEIN (ZLP) GENE IS ASSOCIATED WITH RESISTANCE AGAINST *A. NIGER* IN MAIZE (*ZEA MAYS* L.)**

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**ABSTRACT.** Maize (*Zea mays* L.) constitutes one of the most important crops worldwide with multi-billion dollar annual revenue. The plant is however a good substrate for growth, development and activity of filamentous fungi. A large number of fungal species causes spoilage and accumulation of mycotoxins. Plants restrict the hyphal growth by producing pathogenesis related proteins. So far 17 groups of such proteins are identified. PR-5 group comprises of the thaumatin-like proteins (TLPs), which have diverse modes of actions and act at various stages of fungal attack. Zeamatin-like protein (ZLP) is a member of TLPs, which is basically localized in seeds with enhanced expression during physiological growth and cellular differentiation. However a basal quantity is found in the leaves of many crop plants. Here we report the response of maize plant tissues against *A. niger* inoculation by measuring the variation in expression profile of a zeamatin-like gene. Conventional PCR coupled with RT-qPCR identifies a significant change in the expression magnitude of ZLP in pre- and post-inoculated plant samples. SDS-PAGE, followed by antimicrobial activities against *A. niger*, *E.coli*, *P. aeruginosa*, *B. cereus*, *S. aureus* and *S. typhimurium*, however, do not register a direct relationship with enhancement in gene expression. It is in line with the fact that response to pathogenesis in plants is a multigenic activity involving a series of responsible/induced genes. The assay developed is useful in primary sorting out of the maize hybrids with respect to their resistance against *Aspergillus* spp., especially in areas with high rate of incidence of fungal pathogenesis.

**Keywords:** mycotoxins; thaumatin-like protein; gene expression; SDS-PAGE; antimicrobial.

## **BIOCONTROL OF SOYBEAN CHARCOAL ROOT ROT DISEASE BY USING *TRICHODERMA* SPP.**

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**ABSTRACT.** *Macrophomina phaseolina* (Tassi) Goid, causing charcoal rot disease of soybean, is one of the major factors threatening soybean production, especially in dry years. This pathogen remains the prevailing causal agent of charcoal rot disease that significantly suppresses the yield of a variety of oilseed crops. Its wide host range and ability to survive under arid conditions, coupled with the ineffective use of fungicides against it, have spurred scientific endeavours for alternative avenues to control this phytopathogen. Hence, the present study aimed to provide empirical evidence of the efficacy of fungal isolates of *Trichoderma* spp. as biological control agents against charcoal rot in soybean (*Glycine max* L.). In this study *Trichoderma harzianum* strains 6, 14, 17, 21, 44, *T. asperellum* 26 and *T. virens* 32 were evaluated as potential biological agents for control of this disease. Mycelial growth of *M.*

*phaseolina* strain h-7 was reduced by cell-free and volatile metabolites of *Trichoderma* strains by 16.4 to 64.8%. *T. harzianum* strain Tj17 significantly ( $p \leq 0.05$ ) reduced the incidence (to 7.3%) and severity (to 3%) of disease 42 days after inoculation and increased the 1000 grain weight (to 178 g) in greenhouse conditions. For confirmation of the greenhouse tests, the selected antagonists were re-examined in field trials, where this isolate reduced the disease incidence (to 10%) and severity (to 3%). The overall results of this study show high capability of used antagonists in reduction of disease severity and incidence, and resulting in increased weight of the product. Hence, the findings reported in the present study supported the applicability of Tj17 isolate as possible alternative to fungicides for the control of charcoal rot in soybean.

**Keywords:** *Macrophomina phaseolina*; *Trichoderma harzianum*; *Trichoderma asperellum*; *Trichoderma virens*.

## COMPARISON OF RESPONSE OF CANOLA (*BRASSICA NAPUS* L. CV. HYOLA 401) TO BIOFERTILIZER INOCULATION IN OPTIMAL AND DELAYED CROPPING DATES

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**ABSTRACT.** In order to compare the effects of phosphate solubilizing bacteria as biofertilizer and mineral phosphorous application in optimal date of sowing with delayed cropping date on canola (*Brassica napus* L.) growth and productivity, a split-plot experiment, using randomized complete block design with three replications, was conducted at Dashate-Naz Agronomy Research Station, in 2014. Four levels of bacterial inoculation (*Pseudomonas putida*, *Pseudomonas fluorescens*, singly or in combination) were applied as main plots and five levels of mineral phosphorus (P) application (0, 25, 50, 75, and 100 kg·ha<sup>-1</sup> of mineral phosphorous) were applied as sub plots. Canola plant were sown at two dates of sowing, one at optimal date of sowing (30 Sept., 2014) and the other one month later as delayed cropping (30 Oct., 2014). The results obtained showed that effects of bacterial inoculation on number of seeds per pod, number of pods on plant, and seed yield were significant at one percent probability level at both sowing dates. Moreover, rates of phosphate application had significant effects on all traits at one percent level. Comparing the means showed that application of mineral P resulted in substantial increase in seed yield. At optimal date of sowing, it was shown that while minimum seed yield obtained at control treatment (1600 kg·ha<sup>-1</sup>), the maximum (2980 kg·ha<sup>-1</sup>) obtained with interaction effects of application of both bacterial strains along with 75 kg·ha<sup>-1</sup> mineral P, having no statistically difference with that of *P. fluorescens*, along with 75 kg·ha<sup>-1</sup> mineral P (2940 kg·ha<sup>-1</sup>). It was shown that delayed cropping resulted in decreasing canola growth which is reflected in seed yield and yield components. Minimum seed yield at control plot at first date of sowing (1600 kg·ha<sup>-1</sup>) decreased to 740 kg·ha<sup>-1</sup>, in the second date of sowing, showing 54 % decrease. The maximum seed yield also decreased in delayed cropping, from 2980 kg·ha<sup>-1</sup> at 30 Sept., 2014, as compared to 1074 kg·ha<sup>-1</sup> at 30 Oct., 2014, showing a 64% decrease. The results obtained showed that an increase in P level, eventually enhanced the seed yield. This increasing trend continued until a threshold level (75 kg·ha<sup>-1</sup> of P), after which seed yield showed a declining fashion.

**Keywords:** canola; date of sowing; *Pseudomonas putida*; *Pseudomonas fluorescens*; phosphorous.

## THE EFFECT OF APPLYING EXOGENOUS SALICYLIC ACID ON APHID INFECTION AND ITS INFLUENCE ON HISTO-PHYSIOLOGICAL TRAITS AND THERMAL IMAGING OF CANOLA

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**ABSTRACT.** Insect damage in canola adversely affects its productivity and quality and is considered one of the most important degrading factors in Egypt. The effect of foliar application of salicylic acid (SA) on aphid populations, growth and yield of canola (*Brassica napus*, L.) cv. serw 4 was the major goal of this study. Two experiments were conducted at the farm of Faculty of Agriculture, Suez Canal University, Ismailia, Egypt, during 2014 and 2015 seasons, to achieve this target. Each experiment included four levels of SA (0, 50, 100, 200 mg l<sup>-1</sup>). The experimental results revealed that SA, at low concentration (50 mg l<sup>-1</sup>), was an effective treatment for reduction the number of aphid populations and colony depth on the main inflorescence, contributed with reducing the thickness of secretory tissue of flower pedicel. The level of 50 mg l<sup>-1</sup> of SA-treated canola had the highest number of stomata cm<sup>-2</sup>, along with the lowest width of both stoma and its aperture. Thickness of xylem tissue and the number of xylem vessels bundle<sup>-1</sup> in leaf midrib, reducing sugars and free amino acids was increased at 50 mg l<sup>-1</sup> SA, but free phenolics content did not affected significantly. Under controlled conditions, changes in temperature of infected leaves allowed the discrimination between healthy and infected areas in thermo-image, even before visible symptoms of aphid infestation appeared. The detection of modifications in plants or canopies, associated with low insect severity in the early stages of infestation, was crucial for the targeted, site-specific or on demand application of integrated aphid control. Canola, which was treated with 50 mg l<sup>-1</sup> of SA, gave 30.5 and 27.9 kg of oil ha<sup>-1</sup> over the control. It was concluded that spraying of SA at 50 mg l<sup>-1</sup> was an effective elicitor to diminish the aphid numbers on canola inflorescence and improve its yield.

**Keywords:** oil crop; aphid populations; biochemical; infrared thermal image; histology.

## RESPONSE OF LINOLA (*LINUM USITATISSIMUM* L.) TO DIFFERENT SPACINGS UNDER RAINFED CONDITIONS

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**ABSTRACT.** An experiment was conducted according to randomized complete design to determine best plant spacing and agronomic traits at research farm PMAS Arid Agriculture University Research Farm Chakwal Road, Rawalpindi, during 2008-2009. Three plant spacing's (5, 10, 15 cm) and three row spacing's (10, 20, 30 cm) comprised of the following treatment combinations (T1= 5×10 cm, T2= 5×20 cm, T3= 5×30 cm, T4= 10×10 cm, T5= 10×20 cm, T6= 10×30 cm, T7= 15×10 cm, T8= 15×20 cm, T9=15×30 cm) under rain-fed conditions. The net plot size was 2×6 m with three replications. Days to emergence, plant height at maturity, number of branches per plant, number of capsules per plant, number of seed per capsule, 1000-seed weight, seed capsule ratio, seed yield per plot, biological yield, harvest index, oil concentration and fresh weight of weeds was observed. All agronomic attributes were significantly effected at 15×30 cm spacing, along with oil concentration and fresh weight of weeds, while 10×10 cm row to row and plant to plant spacing had no significant effect.

Plant height (cm), number of capsules per plant was maximum for plant geometry of 15×30 cm and lesser amount of weeds. An increase in row and plant spacing led to significantly higher of branching. Higher plant and row spacing resulted in non- consistent increase in the number of seeds per capsule. Seed yield increased with higher row to row and plant to plant spacings. Yield were lower at the narrow (10×10 cm) row and plant spacing's, compared to higher of 15×30 cm spacing. Thus, it is concluded from this study that Linola should be grown at 300-450 cm grids for higher yield output.

**Keywords:** linola; line spacing; row spacing; oil contents.

## ESSENTIAL OIL AND MICROELEMENT COMPOSITION OF *THYMUS CITRIODORUS* L. AND *LIPPIA CITRIODORA* H.B.K.

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**Abstract.** Lemon verbena (*Lippia citriodora* H.B.K., *Verbenaceae* family) is indigenous to South America and cultivated as an aromatic plant in various parts of world. Lemon thyme (*Thymus citriodorus* L.), *Lamiaceae* family, is a perennial medicinal plant native to southern Europe and is cultivated in the Mediterranean region. These species are cultivated mainly for the lemon-like aroma emitted from their leaves due to the presence of dimethyl-2,6-octadienal, also known as lemonal or citral, which is used in food and perfumery for its citrus effect. The aim of this study was to determine the mineral content and essential oil components of *L. citriodora* and *T. citriodorus* plants grown under semi-arid climatic conditions in Turkey. The aerial parts of lemon thyme and lemon verbena plants were extracted using hydro-distillation. The essential oil composition was analyzed by gas chromatography-mass spectrometry (GC-MS) and the microelement contents of the herbs were examined via inductively coupled plasma-optical emission spectrometry (ICP-OES). The microelement contents were 0.249, 1.630, 16.41, 0.106, and 13.1-36.2 mg kg<sup>-1</sup> for cadmium (Cd), copper (Cu), iron (Fe), and manganese (Mn), respectively, in lemon thyme, and 0.275, 4.584, 248.1, 15.71, and 1.803 mg kg<sup>-1</sup> for Cd, Cu, Fe, Mn, and zinc (Zn), respectively, in lemon verbena. Fifty compounds were identified in lemon verbena essential oil, including limonene (30.33%), *trans*-citral (17%), *cis*-citral (12.77%), caryophyllene oxide (5.71%), and geraniol acetate (4.02%) that together constituted 99.86% of the oil composition. We also identified 22 compounds constituting approximately 85.11% of lemon thyme essential oil, including *trans*-geraniol (30.07%), *trans*-citral (15.06%), *cis*-citral (11.71%), *cis*-geraniol (7.65%), and 3-octanol (6.18%).

**Keywords:** lemon thyme; lemon verbena; lemonal; citral; oil composition.

## ESSENTIAL OIL COMPOSITION OF THREE SPECIES OF *THYMUS* GROWING WILD IN MAZANDARAN, IRAN

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**ABSTRACT.** The genus *Thymus* has a wide distributional range and chemical composition of the essential oils varies with geographical location of collection site, climate and other ecological factors. The essential oils of the aerial parts were obtained by hydrodistillation and analyzed by gas chromatography (GC) and gas chromatography/mass spectrometry (GC-MS). Twenty seven components were characterized in the essential oil of *T. fedtschenkoi*. The major constituents of the oil were carvacrol (69.04%), thymol (5.95%), borneol (5.21%), *p*-cymene

(4.20%), bornyl acetate (2.97%) and 1,8-cineole (2.72%). Twenty two components were characterized in the essential oil of *T. trauvetterri*. The major constituents of the oil were carvacrol (54.02%), thymol (9.29%), borneol (3.51%), *p*-cymene (18.64%) and  $\gamma$ -terpinene (2.97%). Twenty six components were characterized in the essential oil of *T. pubescens*. The major constituents of the oil were carvacrol (13.85%),  $\alpha$ -terpineol (11.49%), thymol (10%), geraniol (9.48%),  $\alpha$ -pinene (8.52%), *p*-cymene (7.66%), camphor (4.66%),  $\gamma$ -terpinene (3.15%) and myrcene (2.22%). Twenty four components were characterized in the essential oil of *T. fallax*. The major constituents of the oil were carvacrol (41.84%), *p*-cymene (12.18%),  $\alpha$ -terpineol (11.49%), thymol (10%),  $\gamma$ -terpinene (8.68%), borneol (5.11%), geraniol (4.35%) and geranyl acetate (2.16%).

**Keywords:** essential oil; *Thymus fedtschenkoi*; *T. trauvetterri*; *T. pubescens*, *T. fallax*

## **EFFECTS OF DENSITY AND RELATIVE TIME OF PIGWEED (*AMARANTHUS RETROFLEXUS*) EMERGENCE ON YIELD OF POTATO (*SOLANUM TUBEROSUM*)**

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**ABSTRACT.** For create of food security is essential increasing of efficiency and more productivity strategic products such as potato. In order to investigate the effects of density and relative time of pigweed emergence on potato, a factorial field experiment was conducted during 2014 based on randomized complete block design with three replications at the Research Station of Borojen, Chaharmahal and Bakhtiari, Iran. Treatments were combination of three different pigweed densities (5, 10 and 15 plants/m<sup>2</sup>) and relative time of pigweed emergence (4 and 8 days before potato, emerged with potato, 4 days after potato emergence). Results indicated that the effects of density and relative time of emergence of pigweed was significant on number of branches per plant, plant height, number of tubers per square meter, biological yield and tuber yield of potato. Also, the interaction of between experimental factors was significant on the biological yield and tuber yield of potato. The earlier emergence and pigweed density led to reduce number of branches per node, biological yield and tuber yield and increase plant height of potato. The presence of weeds caused reduce the size and number of potato tubers. Procedure of decreasing biological yield and tuber yield potato was different with density increasing of pigweed in various relative time of emergence treatment. The highest (39.8 t ha<sup>-1</sup>) and the least (18.4 t ha<sup>-1</sup>) tuber yield were related to density of five plants/m<sup>2</sup> and emergence at 4 days after potato and density of 15 plants/m<sup>2</sup> and emergence at 8 days before potato treatments, respectively.

**Keywords:** competition; height plant; tuber yield; weed.