

Journal of Plant Development Sciences

(An International Monthly Refereed Research Journal)

Volume 11

Number 9

September 2019

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**IDENTIFICATION OF BACTERIAL LEAF BLIGHT (*XANTHOMONAS ORYZAE*)
RESISTANCE GENES IN INDICA RICE (*ORYZA SATIVA* L.) THROUGH MOLECULAR
MARKERS AND MORPHOLOGICAL CHARACTERIZATION FOR CROP
IMPROVEMENT STRATEGY**

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Received-09.09.2019, Revised-27.09.2019

Abstract: The present study was undertaken to confirm the presence of genes responsible for resistance to bacterial leaf blight disease. Ninety-two rice genotypes were evaluated for bacterial leaf blight resistance in the natural condition and under induced epiphytotic conditions. Four gene-specific primers were used to identify bacterial leaf blight resistant genes in these genotypes. Gene-specific markers linked to BLB resistance appeared as *Xa4*_{150bp} (STS marker RM224) in 66 rice genotypes, *xa5*_{1300bp} (STS marker RG556) in 8 rice genotypes, *xal3*_{1000bp} (SNP marker RG136) in 73 rice genotypes and *Xa21*_{1000bp} (STS marker pTA248) in 32 rice genotypes. The seventy-one resistant genotypes had a varying number of BLB resistant genes. All four BLB resistance genes were detected in BC₁F₉ P16, BC₂F₇ P6, and BC₂F₇ P8 lines. Seventeen rice genotypes having a varying number of BLB resistance genes but unable to express resistance in the field conditions due to the effect of environmental factors. The lines BC₁F₉ & BC₂F₇ involved in this study had *xal3* in all the 38 lines (BC₁F₉ & BC₂F₇), while *Xa21* was observed in thirty-one out of 38 lines. The lines BC₁F₉ & BC₂F₇ were found to be BLB resistant at molecular level & artificial induced condition. Application of back cross method was found successful to develop BLB resistant rice varieties using PR106 P2 as donor parent.

Keywords: Gene-specific markers, BLB, Epiphytotic conditions

**EFFICACY OF PGPR AND *TRICHODERMA* ON GROWTH AND YIELD
PARAMETERS OF BELL PEPPER (*CAPSICUM ANNUUM* L.)**

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Received-06.09.2019, Revised-25.09.2019

Abstract: A field experiment was carried out during (2016-17) at experimental farm of Department of Seed Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan-273230 (HP). Plant growth promoting rhizobacteria (PGPR) and biocontrol agent (BCA) were applied to crop as seedling root dip as well as soil application singly and in various combinations. Among different treatments, a combination of PGPR (seedling root dip) + *Trichoderma harzianum* (soil application) performed best w.r.t. various plant growth and yield parameters viz. maximum plant height (70.42 cm), minimum days to 50% flowering (51.00 days), maximum number of fruits/plant (9.50), maximum average fruit weight (44.01g), fruit length (6.68 cm), fruit width (6.18 cm), fruit size (42.05 cm), minimum days to first picking (82.27), maximum harvest duration (58.33 days), maximum number of fruit pickings (7.93), highest fruit yield/plant (922.33 g), fruit yield/plot (13.83 kg) and fruit yield/ha (403.17 q) were recorded maximum with treatment T₅ PGPR (seedling root dip) + *Trichoderma harzianum* (soil application).

Keywords: Bell pepper, PGPR, BCA, *Trichoderma*

INHIBITORY MECHANISM OF N-HEXANE AND DICHLOROMETHANE LEAF EXTRACTS OF *CLERODENDRUM PHLOMIDIS* LINN. ON FOOD BORN PATHOGEN *BACILLUS LICHENIFORMIS*

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Received-03.09.2019, Revised-22.09.2019

Abstract: Bacillus related microbes are mainly found in the severe cases of foodborne infection and many other lethal diseases. Few herbal medicines are effective against *Bacillus licheniformis*, but their mechanism of action is not reported. The antimicrobial potential of herbal extract from *Clerodendrum phlomidis* (n-hexane and dichloromethane extract) was assessed by well diffusion assay which showed a zone of inhibition of 19 and 15.5 mm respectively. Underlying mechanism of action behind the n-hexane and dichloromethane extract of *C. phlomidis* is reported by an *in vitro* study over *Bacillus licheniformis* through FACS, SEM, and DNA fragmentation analysis. Fluorescent activated cell sorting was done to determine membrane potential disruption caused by extracts that revealed dichloromethane has more activity for membrane potential disruption. The SEM analysis of bacteria showed irregular structure in cell wall, blebbing and leakage of cellular contents and disruption of membrane. DNA fragmentation analysis showed a precise smear formation of bacterial cellular DNA providing evidence of its apoptosis. The FTIR spectroscopic analysis of herbal extract was done to determine the dominance of functional groups present within purified antimicrobial extracts and which had shown the dominance of Alcoholic (OH-) group, halogen groups(C-X), Aldehydic (CHO-) groups within them. The antibacterial action is mainly contributed by disruption of membrane potential, degradation of bacterial genomic DNA, damage of bacterial cell membrane and leakage of cellular content. The result provides a significant contribution towards understanding the antibacterial mechanism of n-hexane and dichloromethane extract of *C. phlomidis*.

Keywords: *Clerodendrum phlomidis*, *Bacillus licheniformis*, Herbal extract, FACS, SEM, DNA fragmentation

EFFECT OF ACCELERATED AGEING VARIABLES ON VARIOUS SEEDS QUALITY PARAMETER IN BARLEY (*HORDEUM VULGARE* L.)

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Received-08.09.2019, Revised-26.09.2019

Abstract: Accelerated Ageing test has good Correlation with field emergence and storage potential of Seeds. In This regard study was conducted to standardized accelerated ageing duration along with temperature variables by using six barley genotypes Viz. ALFA-93, BH-393, BH-75, BCU-3, RD-2552 and K-551. All Six varieties was divided in two seed lots subjected to accelerated ageing at two time variables 42±1°C and 45±1°C for 48 and 72 hrs separately on 100% relative humidity. Seeds were exposed to accelerated ageing conditions at two temperature 42°C and 45°C for different time intervals 48, 72 hrs; the viability reduced significantly ranging from 40 to 60%. In the present study genotypes BH-393, BCU-73 were observed to be tolerant to stress conditions during accelerated ageing at 42°C for 48 hrs. whereas Genotypes BH-393 and RD-2552 were observed most tolerant to stress conditions during accelerated ageing at 45°C for 48 hrs in present study, the genotypes showing high resistance to accelerated ageing test were also showing high standard germination in fresh seed ranging from 94 to 100%. Results revealed that the germination percentage for fresh seed lot was above the minimum seed certification standard whereas in accelerated aged seed lots, the standard germination, vigor index, rate of germination and dehydrogenase activity declined significantly for all the six genotypes. All the genotypes were found significantly different for vigor and viability tests. After accelerated ageing, the genotypes, BH-393 and BCU-73 were having significantly higher

standard germination, vigor, rate of germination and enzymatic activity as compared to other genotypes indicating their superiority over others. A higher electrical conductivity of accelerated aged seed in barley further confirmed the accelerated ageing results in to increase permeability of cell membrane and release of food reserves.

Keywords: Accelerated ageing, Standard Germination, Barley seed

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COMPARATIVE EFFICACY OF DIFFERENT ORGANIC MANURES AND FERTILIZERS ON GROWTH AND YIELD OF KAPOOR TULSI (*OCIMUM KILIMANDSCHARICUM* GUERKE) UNDER MID-HILL CONDITION OF HIMACHAL PRADESH

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Received-10.09.2019, Revised-27.09.2019

Abstract: The present studies were conducted on Kapoor Tulsi (*Ocimum kilimandscharicum* Guerke) during the season of 2017-18 at the experimental farm of Department of Forest Products, Dr. YSP University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh (India). In this experiment ten treatments viz., T₁: Control, T₂: FYM (15t/ha), T₃: NPK (120:60:60 kg/ha), T₄: FYM+NPK (15 t/ha + 120:60:60 kg/ha), T₅: Jeevamrutha-desi cow (125 l/ha, 3%), T₆: Jeevamrutha-jersey cow (125 l/ha, 3%), T₇: Panchagavya-desi cow (50 l/ha, 5%), T₈: Panchagavya-jersey cow (50 l/ha, 5%), T₉: Vermicompost (3t/ha) and T₁₀: Vermicompost + NPK (3 t/ha + 120:60:60 kg/ha) were evaluated in RBD design with three replications on growth and yield of Kapoor tulsi. The results revealed that the combined application of Vermicompost and NPK (3 t/ha + 120:60:60 kg/ha) produced highest growth and yield followed by T₄>T₃>T₂>T₇. The Benefit Cost Ratio (BCR) among the various treatments shows that the NPK (T₃) (120:60:60 kg/ha) was found best (1.69) due to lowest cost and higher yield followed by T₇>T₈>T₅>T₄.

Keywords: Manure, Tulsi, Herbage, Essential oil, Growth, Yield

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MICROSATELLITE MARKERS (SSR'S) FOR REVEALING POLYMORPHISM AND IDENTIFICATION AMONG WILLOWS CLONES

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Received-02.09.2019, Revised-22.09.2019

Abstract: Microsatellite markers (SSR's) were found effective in revealing polymorphisms among twenty two different species/clones of Willows. Out of 10 SSR primers only seven primers produced SSR profiles with intense banding pattern and generated a unique set of amplification products. Out of the total 24 scorable bands, 16 showed polymorphism and eight bands exhibited monomorphism with an average of 3.43 bands per primer. A unique band of approximately 100 bp was generated by SB-80 for *S. udensis*. Jaccard's similarity correlation coefficient values was highest value (0.98) between two male genotypes of *Salix tetrasperma* [*S. tetrasperma* (TFB) and *S. tetrasperma* (LNM)] and lowest (0.64) between *S. udensis* and *S. nigra*, *S. udensis* and *S. tetrasperma* (TWE) and between *S. matsudana* (PN-722) and *S. pierotii* and 799. The dendrogram exhibited six clear clusters with *S. udensis* coming out as an outline. SSR primer namely SB-80 produced unique band present only in *S. udensis*. This information could be used for characterizing particular genotypes.

Keywords: Clones, Microsatellite markers, Willows

GROWTH INDICES, HARVEST AND ATTRACTION INDEX OF WHEAT CROP AS INFLUENCED BY DIFFERENT VARIETIES AND NITROGEN SOURCES

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Received-06.08.2019, Revised-25.09.2019

Abstract: A field experiment was conducted at Agronomy Research Area, CCS HAU Hisar to study the influence of nitrogen source and varieties on growth indices and harvest index of wheat crop during *rabi* season of 2017-18 in split plot design with three replication. In the main plots there were five wheat varieties (WH 1105, WH 1142, HD 3086, HD 2967 and DBW 88) and in sub plots three nitrogen sources *viz.* 100 RDN through inorganic source (urea), 100 per cent RDN through organic source (vermicompost) and 50 per cent RDN through inorganic + 50 per cent RDN through organic source. Higher leaf area index and leaf area duration was recorded under variety HD 3086 and 100 % RDN through inorganic source (urea). Among varieties non significant differences were observed in respect of crop growth rate except at 31-60 days after sowing. Neither the varieties nor the nitrogen sources had any significant effect on relative growth rate, attraction index and harvest index.

Keywords: Wheat, Varieties, Growth indices, Nitrogen sources, Harvest index

EFFECT OF PHOSPHORUS AND MOLYBDENUM ON YIELD AND NUTRIENT UPTAKE BY CHICKPEA UNDER RAINFED CONDITIONS OF MADHYA PRADESH

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Received-10.09.2019, Revised-27.09.2019

Abstract: A field experiment was carried out to assess the growth, yield and chemical traits of chickpea cv. JG-11. The experiment was laid out in Randomized Block Design with three replications for chickpea crop consisted of 16 treatments i.e. four levels of phosphorus (0, 40, 60 and 80 kg ha⁻¹) and four levels of molybdenum (0, 0.5 1.0 and 1.5 kg ha⁻¹). The results revealed that application of phosphorus and molybdenum had a significant influence on plant growth, yield and nutrient uptake by chickpea. Grain and straw yield increased significantly up to 60 kg P₂O₅ ha⁻¹ and giving 61.2 & 17.2 % and 42.5 & 7.3% higher over control and 40 kg P₂O₅ ha⁻¹, respectively. Under different doses of molybdenum, maximum grain (1633.2 kg ha⁻¹) and straw (1956.5 kg ha⁻¹) yield was observed with 1.5 kg molybdenum which was significantly higher over control and 0.5 kg Mo ha⁻¹ and was at par with 1.0 kg Mo ha⁻¹ treatment. Significant increase in nitrogen, phosphorus and molybdenum uptake in grain and straw was observed with the application of phosphorus and molybdenum over the control.

Keywords: Chickpea, Growth, Molybdenum, Nutrient uptake, Phosphorus, Yield

A LONG TERM EFFECT OF DIFFERENT MODES AND LEVELS OF FYM AND FERTILIZER NITROGEN ON AVAILABLE MICRONUTRIENTS OF SOIL UNDER PEARL MILLET WHEAT CROPPING SYSTEM

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Received-03.09.2019, Revised-24.09.2019

Abstract: An ongoing long-term field experiment on integrated nutrient management (FYM and fertilizer N) under Pearl millet wheat cropping sequences, established in October 1967, at research farm, department of soil science, CCS HAU, Hisar, India was the experimental site for the study. The experimental treatment consisted of three level of FYM (15, 30 and 45 Mg/ha) till 2007-08 and 5, 10 and 15 ton per hectare from 2008-09 onwards. Every Kharif crop (summer season), in every Rabi crop (winter season) and in both (Kharif and Rabi) the crop was the mode of application. An absolute control without application of FYM in any of the seasons was maintained as a control. These 10 treatments(3 FYM level x 3 modes of application+ 1 FYM control) were allocated in the main plots and each main plot was subdivided into three subplots receiving fertilizer N at 0, 60 and 120 kg N/ hectare in each season through urea using split plot design. All the treatments were replicated thrice. Each subplot measuring 10 x 5 m. FYM was incorporated in top 15-20 cm layers 3 to 4 weeks before sowing the crops. Significant increase in micronutrients (Zn, Mn, Cu, Fe) when FYM applied at 15 Mg/ha, followed by 10 and 5 Mg/ha and with application of fertilizer nitrogen from control to 120 kg/ha.

Keywords: Effect, Micronutrients, Fertilizer, Nitrogen, Wheat

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SEASONAL INCIDENCE AND EXTENT OF DAMAGE BY CUCURBIT FRUIT FLY, *BACTROCERA CUCURBITAE* (COQ.) ON SPINE GOURD (*MOMORDICA DIOICA* ROXB.)

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Received-15.07.2019, Revised-10.09.2019

Abstract: Spine gourd *Momordica dioica* (Roxb.) is an important potential cucurbitaceous crop, its fruit gets severely affected by cucurbit fruit fly (*Bactrocera cucurbitae* Coq.). Its population of 0.2 adult/plant was first observed during first week of August which remained till third week of October. The fruit fly adult population was increased gradually afterwards to reach highest number with 3.0 adult/plant in second week of September, whereas the maximum and minimum temperature was observed at 31.1°C and 23.0°C and rainfall 8.4mm, while morning and evening relative humidity was 95% and 74%, respectively. However, after attaining peak, the population reduced and minimum level of none adult/plant was recorded in last week of October (43th SMW). The fruit infestation percentage of spine gourd was first observed on fruit number and weight basis at 19.61 and 19.28 per cent respectively, whereas the larval density of 2.57 maggot/fruit was observed during the first picking of fruits (July, 31). Thereafter, the fruit infestation percentage showed a gradual increasing trend and reach peak infestation with 43.23 and 43.31 per cent respectively, when the maggot density of 6.85 maggot/fruit was observed during fifth picking of fruits (September, 30). The infestation percentage was decreased by 32.58 and 35.99 per cent respectively, when the maggot density was also decreased in the ranges 4.58 maggot/plant in last picking of fruits (October, 15). Hence, the maximum plant protection measures should be applied in the month of September for the reduction of pest population and damage.

Keywords: Cucurbit fruit fly, *Bactrocera cucurbitae*, Gourd, *Momordica dioica*, Seasonal incidence

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EFFECT OF ACCELERATED AND NATURAL AGEING ON SEED STORAGE POTENTIAL OF WHEAT SEED (*TRITICUM AESTIVUM* L.)

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Received-08.09.2019, Revised-26.09.2019

Abstract: Seed of six varieties of wheat (*Triticum aestivum*) viz. C-306, PBW-502, WH-542, WH-711, WH-283 and RAJ-3765 were subjected to natural vis-à-vis accelerated ageing conditions and evaluated for relative storage potential of the seeds of respective varieties and ageing conditions. Seeds of all the varieties found 18 months of storability except the variety C-306 in term of minimum seed certification standards (MSCS) for germination percentage. Whereas variety RAJ-3765 was adjudged to have poor storability as it showed 18 months of seed storage potential under ambient conditions. After two years of storage all the wheat varieties loss their germination below minimum seed certification standards (MSCS). Maximum germination percentage retained by variety PBW-502(79.00), considered to have good storability as compared to others whereas minimum germination percentage retained by variety C-306(71.33) found to have poor storability. In case of accelerated aged seed lot maximum germination percentage retained by variety PBW-502(55.00) showed good storability whereas RAJ-3765(44.00) retained minimum germination percentage which showed poor storability among all varieties followed by C-306(47.00). Thus in both conditions natural and accelerated aged seed PBW-502 was adjudged good and RAJ-3765 was as poor storage genotypes. Secondly accelerated aged seed is having poor storability as compare to natural aged seed.

Keywords: Accelerated ageing, Natural ageing, Wheat, Seed quality, Seed storability