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ABBREVIATION LIST

RD	Recommended doses
MASR	Ministry of Agriculture and soil reclamation
FYM	Farmyard manure
CRS	Compost rice straw
CTR	Compost town refuse
HA	Humic acid
CK	Cytokinin
Y	Yeast
BF	Biofertilization (Mixture of <i>Azotobacter chroococcum</i> , <i>Bacillus megatherium</i> and <i>Bacillus circulans</i>)
PSB	Phosphate solubilizing bacteria
OM	Organic matter
C. sand	Coarse sand
F. sand	Fine sand
S.C.L	Sandy clay loamy
SP	Saturation percentage
EC	Electrical conductivity

FAO	Food and Agricultural Organization
WHO	World Health Organization
IAA	Indole acetic acid
GA₃	Gibberellic acid
ABA	Absecic acid
MSW	Municipal solid wastes
MSS	Municipal sewage sludge
DAP	Days after planting
PTWI	provisional tolerable weekly intake
ROS	Reactive Oxygen Species
IARC	International Agency for Research on Cancer
HbO₂	Oxyhaemoglobin
Hb⁺	Methaemoglobin
OBF	Organic based fertilizers
PGPM	plant growth-promoting microorganisms
RP	Rock phosphate
JA	Jasmonic acid
MeJA	Methyl jasmonate
CRB	Complete Randomized Blocks
RDF	Recommended dose fertilizer
SOC	soil organic carbon
VAM	vesicular-arbuscular mycorrhizal
AM	Arbuscular mycorrhizal

5- SUMMARY AND CONCLUSION

The excessive use of inorganic fertilizers, especially N, P and K represents the major cost in plant production and creates pollution of agro ecosystem as well as deterioration of soil fertility. Under these circumstances, supplementing or substitution of inorganic fertilizers with organic sources, particularly those of microbial origin is needed. So the present investigation was carried out to investigate the possibility of partial or complete substituting chemical fertilizers by bio fertilizer or organic manure or both of them for producing the highest safe yield of potato and onion crops.

In order to obtain the objective of this investigation; a field experiment was undertaken at the experimental farm of the Faculty of Agric. El-Mansoura Univ. during the winter season of 2011-2012 to investigate the various combinations among organic manures, growth regulators and biofertilizers on the production of safe and economic onion bulbs and potato tubers.

Twenty five treatments were arranged in split – split block design with 3 replicates, which were the simple possible combination between three sources of organic manure [Farmyard manure (FYM), compost rice straw (CRS) and compost town refuse (CTR)] as main plots; four treatments of growth regulators (0, humic acid, cytokinin and yeast) as sub plots. Each treatment was studied twice; once in the presence of mixture of multi strains inoculants and the other without it which devoted as sub-sub plot.

Also, the recommended doses of N, P and K fertilizers for onion and potato used as a comparable control treatment.

The obtained results could be summarized as follows:

1. Vegetative growth parameters:-

- The average values of all plant growth parameters i.e. plant length, number of leaves, fresh and dry weight for potato and onion plants treated with the different organic manures in single form were less than that obtained for the control treatment. Comparing with the control treatment the rete of decreases in dry matter content in plant foliage (for example) were 17.1, 3.5, 30.3 in potato plant and 3.99 2.63 and 28.87 (%) in onion plant for the

treatments of FYM, CRS and CTR, respectively. The same trend was realized for the other plant growth parameters.

- Treating potato tubers and onion seedlings with the studied growth regulators significantly increased the mean values of all vegetative growth parameters of potato than those obtained from the untreated plants, the highest values were recorded for the plants treated with humic acid, while the lowest one were obtained from the untreated plants.
- Co inoculation of potato tubers with the mixture of multi strains inoculants tended to increase the mean values of all vegetative growth parameters.
- The average values of all growth parameters studied were significantly affected by the addition of all investigated treatments, the highest mean values were recorded for the plants treated with the combination between C.R.S, H.A and BF.

2. Yields and its components :

- Using compost rice straw was superior for recording the highest values of fresh weight of tuber (g plant^{-1}), No. of tubers per plant, average tuber weight/ g and dry matter of tubers (%) as well as total yield; (ton fed^{-1}), following with farmyard manure and lastly compost town refuse.
- The effect of humic acid, cytokinin and yeast as solely form on the mean values of yield and yield components of potato and onion plants showed a significant increases in all parameters under study for the plants treated with any of these growth regulators over that obtained from the untreated plants. Treating onion and potato plants with humic acid was superior for increasing the mean values of yield and its components following with yeast extract and finally cytokinin.
- The highest values recorded for the plants treated with the mixture of inoculants, while the lowest one was realized for the uninoculated plants.
- As for the interaction effect, the most suitable treatment which realized the highest values of yield and its components was connected with the plants treated with CRS + HA + BF. In this respect, the mean values of yield and its components for potato tubers and onion bulbs were approximately similar to that obtained from the control treatment with insignificant effect among them.

3. Chemical constituents of potato plant foliage (60days)

- Single addition of FYM, CRS or CTR significantly decreased the mean values of chlorophyll (a, b & a+b mg g⁻¹ F.W) as well as N, P and K (%) in potato leaves as compared to the control treatment. In this respect, a superiority effect was realized within the organic manures for the plants treated with compost rice straw for all the aforementioned traits following with FYM and lastly CTR.
- A stimulation effect was happened on the mean values of the previously mentioned traits due to an application of the studied growth regulator in single form comparing with the untreated plants. Such effect was more pronounced for the plants treated with H.A, which recorded the highest values; for total chlorophyll, N, P and K, respectively.
- Treating the tubers of potato before sowing with the mixture of biofertilizers gave the highest values for all the aforementioned traits as compared to the uninoculated plants.
- Co inoculation of potato tubers with the mixture of multi strains in combination with organic manure and growth regulators has been recorded a stimulation effect on the average values of all the aforementioned traits, the highest mean values were recorded for the treatment of CRS + HA + BF, while the lowest one was connected with the treatment of CTR without any of growth regulators and biofertilization.

4. Chemical constituents of potato tubers and onion bulbs.

- Adding of compost rice straw in single form significantly increased the mean values of N, P and K % and Fe, Zn and Mn (mg kg⁻¹) of potato tubers and onion bulbs over those obtained for the control treatment. Such effect was not realized for farmyard manure or compost town refuse, whereas the mean values of such traits were insignificantly decreased less than the control treatment.
- The highest mean values for the previously mentioned traits were found to be associated with the addition of humic acid for N, P and K elements, while such effect was realized for the treatment of yeast extract for Fe, Zn and Mn. The average mean values of all nutritional elements of potato tubers and onion bulbs for both growth regulators were significantly increase over those obtained for the control treatment.

- Using the mixture of multi strains inoculants was superior for increasing the mean values of the nutritional elements in potato tubers and onion bulbs than those obtained from the uninoculated plants.
- Nutritional elements concentrations in potato tuber and onion bulbs as affected by the interaction between all treatments under study are significantly affected except for the concentration of Mn and K which were had no significant effect, the most suitable treatment which realized the highest values were connected with CRS + HA +BF. In addition, these mean values tended to increase than those obtained for the control treatment (1.49, 0.255, 10.39 and 5.09 for N, P, Fe and Zn respectively).

5. Quality parameters of potato tubers and onion bulbs.

- Quality parameters of potato tubers; crude protein, total carbohydrates, starch (%) and vitamin C ($\text{mg } 100\text{g}^{-1}$) and onion bulbs; T. carbohydrates (%) and V.C ($\text{mg } 100\text{g}^{-1}$) were significantly increased due to solely addition of compost rice straw and significantly decreased for the treatments of FYM and CTR as compared to the control treatment.
- The effect of growth regulators studied on quality parameters of potato tubers and onion bulbs tended to increase than those obtained from the untreated plants.
- Treating the tubers of potato tubers and onion seedlings with the mixture of multi strains inoculants recorded more pronounced affect on the average values of all the previously mentioned traits over those obtained for the uninoculated tubers and bulbs.
- As for the average values of crude protein, total carbohydrates, starch (%) and vitamin C ($\text{mg } 100\text{g}^{-1}$) in potato tubers and T. carbohydrates (%) and V.C ($\text{mg } 100\text{g}^{-1}$) in onion bulbs as affected by the combination between the various treatments under investigation; a positive effect was happened on the mean values of all quality parameters under study due to using the combination between the studied parameters. In this respect the highest mean values of all quality parameters as affected by this interaction was realized for the treatment of CRS + HA + BF.

6. Nitrate accumulation in potato tubers and onion bulbs.

- Single application of the different organic sources studied significantly decreased the contents of nitrate in potato tubers and onion bulbs as compared to the control treatment.

- The effect of growth regulators studied on NO₃-N of potato tubers and onion bulbs tended to decrease for the plants treated with growth regulators than those obtained from the untreated plants.
- Co inoculation of potato tubers and onion bulbs with the mixture of microorganisms sharply decrease the main values of nitrate less than those obtained for the uninoculated tubers.
- As for nitrate accumulation (mg kg⁻¹) as affected by the combination between the various treatments under investigation the lowest value of nitrate (27.12) in potato tubers were obtained for the treatment of CRS + HA + BF. and all these values were better than that obtained for the control treatment.

7. Heavy metals (Pb, Cd and Ni) in potato tubers and onion bulbs:

- Within the sources of organic manures used, the highest contamination with heavy metals was happened for the treatment of compost town refuse following with farmyard manure, but the less contamination was realized for the plants treated with compost rice straw. For all sources of organic manure, the average mean values of heavy metals in potato tuber and onion bulbs were less than those obtained for the control treatment.
- Treating potato and onion plants with any of growth regulators investigated significantly decreased the average values of the previously mentioned traits than those obtained for the control treatment and this effect was more pronounced for the plants treated with cytokinin following by yeast extract and lastly humic acid.
- Inoculation of potato tubers and onion seedlings with the mixture of microorganisms slightly and significantly increased the mean values of Pb, Ni and Cd (mg kg⁻¹) in potato tubers and onion bulbs as compared to the uninoculated treatment.
- As for the interaction effect, the highest contamination with Pb, Ni and Cd was connected with the combination among town refuse and the other studied treatments, while the lowest contamination was happened due to an addition of CRS as a source for organic manure.

8. DTPA-extractable heavy metals in soil after harvesting:

- The concentrations of all heavy metals were significantly affected due to an addition of the organic manures under investigation and recorded the highest values for the treatment of compost town refuse, while the lowest one was attained to the treatment of compost rice straw compared with the control which have been recorded a higher amounts of these

elements more than that obtained from the treatments of organic manures as solely addition.

- The mean values of all the aforementioned traits were significantly decreased due to an application any of growth regulators under study than those obtained for the untreated plants.
- A depression effect on the concentrations of the studied heavy metals in the soil after cropping due to an inoculation of potato tubers and onion seedlings with the mixture of multi strains inoculants whereas, the average values of available Pp, Ni and Cd were significantly decreased for the inoculated soils than those obtained for the uninoculated one
- The comparison among the means of the various combined treatments of organic manures, growth regulators and biofertilization reflected a significant differences between the average values of available Pb, Ni and Cd concentrations in the soil after harvesting of onion and potato crops. In this respect, the lowest level of heavy metal studied were recorded for the treatment of CRS + HA + BF, while the highest one was connected with the treatment of compost town refuse in the absence of growth regulators and biofertilization.

☒ CONCLUSION :

Under the same condition of this investigation it could be concluded that; inoculation of potato tubers and onion seedlings with the mixture of microorganisms in the presence of organic manures and growth regulators under investigation gave the highest values of all parameters under study and such effect was more pronounced for the treatment of CRS + HA +BF.

The superiority effect of compost rice straw may be refer to the increasing of its content from the nutritional elements especially nitrogen which affected on the decreasing of the value C: N ratio than that obtained for farmyard manure or compost town refuse. In addition, treating the compost rice straw with the mixture of microorganisms in the presence of humic acid resulted in increasing the utilization of nutritional element and organic acids as a result of the activity of microorganisms and the effect of humic acid. This effect was reflected on increasing the yield and quality parameters of potato tuber and onion bulbs.

Thus, it could be recommended that inoculation of onion seedlings and potato tuber with the mixture of multi strains inoculants combined with compost rice straw at rate of $15 \text{ m}^3 \text{ fed}^{-1}$ and the addition of humic acid are considered as the most suitable treatment for realizing the highest economic and safe yield of onion bulb and potato tubers.