Minia J. of Agric. Res. & Develop.
Vol. (٣٢) No. ٥ pp ٧٧٩-٧٩١, ٢٠١٢

FACULTY OF AGRICULTURE

RESPONSE OF SOME LUPIN GENOTYPES FOR RHIZOBIUM AND ZINC FERTILIZATION

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Received ١٠ Dec. ٢٠١٢ Accepted ٢٤ Dec. ٢٠١٢

ABSTRACT

The present study was carried out at farms of both New Valley and Mallawy Research Stations, Agricultural Research Center (ARC), during ٢٠٠٩/٢٠١٠ and ٢٠١٠/٢٠١١ growing seasons. The treatments were arranged in a split - split plot design, with three replications, the lupin genotypes were arranged in the main plots, while rhizobium inoculations were arranged in the sub plots, the rates of zinc were randomly allocated in sub-sub plots. Three white lupin genotypes (Giza١, Giza٢ and Improved Dijon ٢), two strains of rhizobium inoculation and three rates of Zinc applications were used.

At New Valley and Mallawy there were significant differences among the three lupin genotypes in terms of all characters (number and weight (g) of nodules/root, seed yield/plant, ١٠٠-seed weight and seed yield ard./fed.). Results indicated that the brady rhizobium strains ARC ٤٠٩ ($R_{١}$) was the better than ARC ٤١٩ ($R_{٢}$). A rate of ٠.٦ g/kg seeds ($Zn_{٢}$) recorded the best treatment of Zn application at most cases. The interaction effect between genotypes and rhizobia at two locations was significant for number and weight of nodules per root (g). The best strain should be select for crop and genotype for location because there is a specialization for rhizobia accordance its importance in

legume nodulation, which not change the natural biodiversity or impact on newly released strain.

INTRODUCTION

Lupin cultivation in the old world is often associated with the times of the ancient Egyptian civilization (Zhukovsky, ١٩٢٩). It is, however, more likely that originally white lupin was introduced into cultivation in ancient Greece (Kurlovich, ٢٠٠٢) where its greatest biodiversity was concentrated and wild-growing forms have been preserved until nowadays (ssp. *graecus*). On the Balkan Peninsula another subspecies of white lupin (ssp. *termis* and ssp. *albus*) turned wild and grow now in natural environments. The Grecian genesis of cultivated lupin is testified by lupin's Greek name *termis*, which may be translated as "ardent". Until now, in many countries of the world water-soaked and boiled lupin seeds are sold on markets and in bars as delicacies (like sunflower seeds). White lupin dispersed step-by-step from Greece to adjacent countries, in particular, to Egypt and Ancient Rome.

Zinc (Zn) is an important micronutrient essential for plant growth and development. The soil in dry regions is often poor in plant-available Zn associated with high calcium carbonate content and alkaline pH (Liu, ١٩٩٦). Moreover, Zn is important for its ability to influence auxin levels and has long been known to be a co-enzyme for production of tryptophane, a precursor to the formation of auxin. (Bennett and Skoog, ٢٠٠٢; Waraich *et al* ٢٠١١). Increase in auxin levels due to Zn application enhances the root growth. Zn deficiency symptoms such as stunted stems and chlorotic leaves were often observed in maize plants grown in the field (Liu, *et al* ١٩٩٣; Liu, ١٩٩٦). In cabbage, Zn deficiency lowered osmotic potential and increased water saturation deficit (Sharma *et al* ١٩٨٤, ١٩٩٤).

Bacteria of the genus Rhizobium play a very important role in agriculture by inducing nitrogen-fixing nodules on the roots of legumes such as peas, beans, clover and alfalfa. This symbiosis can relieve the requirements for added nitrogenous fertilizer during the growth of leguminous crops. The Rhizobium group is studying the bacterial and legume genes involved in establishing and maintaining the symbiosis. This will provide background knowledge for use in applied objectives as well as yielding a wealth of fundamental knowledge with wide implications. A continuous investigation of the bacterial and plant genes specifically those induced during the symbiosis is very important. The expression of "nodulation" genes in the bacteria is activated by signals from plant roots and as a result the bacteria synthesise signals that induce a nodule meristem and enable the bacteria to enter this meristem via a plant-made infection thread. The objective of this investigation to study responses of three lupin varieties under rhizobium inoculation and zinc fertilization.

MATERIALS AND METHODS

A field experiment was carried out at farms of both New Valley and Mallawy Research Stations, Agricultural Research Center (ARC), during two successive cool seasons, (٢٠٠٩/٢٠١٠ and ٢٠١٠/٢٠١١) to evaluate some lupin genotypes as affected by Rhizobium inoculation and Zinc fertilization. Soil samples were collected from different locations of the experimental sites before sowing for chemical and mechanical analysis (Table ١).

The following treatments were studied:

A-Genotypes:

Three white lupin genotypes namely; Giza١, Giza٢ and Improved Dijon ٢.

B-Rhizobium inoculation:

Brady rhizobium strains ARC ٤٠٩ ($R_{١}$) and ARC ٤١٩ ($R_{٢}$) were used to inoculate seeds of lupin genotypes. They were used as seed coating inoculation at the roots ٤ g inoculum for ١٠٠ g seeds with seed Coad $>١٠^{٤}$ cell per seed. These bacteria were kindly obtained from Bio-fertilizers Production Unit, Agricultural Research Microbiology.

C-Zinc fertilizer:

Three rates of Zinc-EDTA ١٤٪; ٠.٠٠ ($Zn_{٠}$), ٠.٣ ($Zn_{١}$) and ٠.٦ ($Zn_{٢}$) g/kg seeds *i.e.* were used. Each treatment was mixed thoroughly with seed in the presence of water contained ٤ drops of the adhesive materials (Triton B) at rates of ١٠ ml/kg seeds. Seeds were left in open air until complete dryness.

The treatments were arranged in a split - split plot design, with three replications. The lupin genotypes were arranged in the main plots, while rhizobium inoculations were arranged in the sub plots. The rates of zinc were randomly allocated in sub-sub plots. Experimental plot included four ridges, ٣m long and ٦٠ cm apart, (plot area ٧.٢ $m^{٢}$).

Planting took place at early November with single seeded/hill, ٢٠ cm an apart, in the two years of experimentation.

At growth stage, plant sample were collected from each experimental plots (٦٠ days after planting) to determine number and weight of nodules (g) /plant according to Vincent J.M., (١٩٧٠). At harvest, the following characters were recorded: seed yield per plant, ١٠٠-seed weight (g) and seed yield ard/fad..

Table ١: The mechanical and chemical analysis of soils over two seasons (٢٠٠٩ + ٢٠١٠ / ٢٠١١).

Properties	Mallawy	New Valley
Mechanical:		
Sand %	٧.٩٠	٧١.٥
Silt %	٥٤.٥٠	٩.٠
Clay %	٣٧.٦٠	١٩.٠
Textural grade	Silty clay loam	Sandy loam
Chemical:		
PH	٨.٢٠	٧.٦٠
E.C.(ds/m)	١.٣٥	٠.٨٩
Organic matter%	١.١٨	٠.٢٥
Soluble cations		
Ca^{++}	٦.٢٥	١.١٢
Mg^{+}	٠.٧٦	٠.٩٠
K^{+}	٠.٢٠	٢.٥٠
Na^{+}	٢.٨٥	٣.٣٠
Soluble anions		
$CO^{٣-}$	٠.٠٠	٠.٠٠
$HCO^{٣}$	٢.٠٥	١.١٩
Cl^{-}	٢.٢٥	١.٢٥
$SO_{٤}^{-}$	٥.٨٥	٢.٤٠
Available N (ppm)	٢٠.٣٥	١٢.٣٢
Available P (ppm)	٨.١٥	٧.١٨
Available K (ppm)	١٨٣.٠	١٠٥.٠

The analysis of variances and the least significant differences (LSD) test at ٥٪ were used according to Snedcer and Cochran (١٩٨١).

RESULTS AND DISCUTION

A-Genotypes differences:

There were significant differences among the three lupin genotypes (Giza ١, Giza ٢ and Im. Dijon ٢) in terms of all characters (number and weight (g) of nodules/root, seed yield/plant, ١٠٠-seed weight and seed yield ard./fed.), at New Valley and Mallawy, Table (٢). Giza ١ variety recorded the highest number and weight (g) of nodules/root and seed yield/plant (g) in the first season.

Table ٢: Differences of lupin genotypes in number and weight of nodules/root, seed yield/plant, ١٠٠- Seed weight and seed yield (ard/fed.) at New Valley and Mallawy, ٢٠٠٩/٢٠١٠ and ٢٠١٠/٢٠١١ seasons.

location	season	variety	No. of nodules /root/plant	Weight of nodules (g)/plant	Seed yield/ plant (g)	١٠٠-seed weight (g)	Seed yield (ard/fed)
New valley	٢٠٠٩/٢٠١٠	Giza١	٢٩.٤٢	٠.٢٥٣	٢٥.٢٦	٣٦.١٢	٥.٦٦
		Giza٢	٢٨.٢٩	٠.٢١٢	٢١.٥٦	٣٥.٢٢	٤.٦٦
		Imp. Dijon ٢	١٩.٨٣	٠.٢١٨	٢٣.٦٩	٣٧.٧٠	٥.٨٣
		LSD٠.٠٥	٠.٩٦	٠.٠٢٥	٠.٩٩	١.٢٦	٠.٠٩
	٢٠١٠/٢٠١١	Giza١	١٩.٠٠	٠.٢١٤	٢٥.٤١	٣٥.٠٩	٨.٢٣
		Giza٢	٢٧.٢٢	٠.٢٩١	٢٣.٢٣	٣٦.٥٦	٧.٤٨
		Imp. Dijon ٢	١٨.١١	٠.٢٢٧	٢٢.١٤	٣٦.٩٠	٨.٢٦
		LSD٠.٠٥	٥.٣٨	٠.٠٤٤	١.٩٣	١.٢٨	٠.١٥
Mallawy	٢٠٠٩/٢٠١٠	Giza١	٣١.١١	٠.٣١٢	٢٦.٦٠	٣٤.٤٢	٥.٩٣
		Giza٢	٢٦.٩٦	٠.٢١٩	٢٣.٦٥	٣١.٦٩	٦.٤٥
		Imp. Dijon ٢	٢٤.٩٢	٠.١٨٥	٢٧.٢٩	٣١.٦٨	٦.٢٩
		LSD٠.٠٥	٢.٤٧	٠.٠٣٥	١.٢٥	٢.٣٢	٠.٠٦
	٢٠١٠/٢٠١١	Giza١	٣١.٧١	٠.٣٢	٢٥.٧٤	٣٦.٤٦	٧.٠٧
		Giza٢	٢٤.٢٣	٠.٢٤	٢٢.٩١	٣١.٨٢	٥.٨١
		Imp. Dijon ٢	٣٠.٨١	٠.٣١	٢٣.١٦	٣٢.٤٣	٦.٦٩
		LSD٠.٠٥	١.٠٨	٠.٠١٨	١.٥٤	٣.٣٧	٠.٠٤

Meanwhile, Imp. Dijon ٢ was the best genotype for ١٠٠-seed weight and seed yield ard./fed. at New Valley, at the second season.

Results indicated that Giza١, Giza ٢ and improver Dijon ٢ recorded the highest estimates of seed yield/plant (g), number and weight of nodules/root (g), ١٠٠-seed weight and seed yield ard./fed. respectively. On the other hand, at Mallawy, results showed that Giza ١ recorded high estimates of number and weight of nodules/root (g) and ١٠٠-seed weight. Meanwhile, Giza ٢ recorded the highest seed yield (ard./fed.). Imp. Dijon ٢ reported that the heaviest genotype for seed yield/plant (g) in the first season.

B: Rhizobia effect:

Data are presented in (Table ٣), revealed that there were significant differences among seasons and locations for number and weight of nodules per root, seed yield/plant, ١٠٠-seed weight and seed yield (ard./fed.). Results indicated that the brady rhizobium strains ARC ٤٠٩ ($R_{١}$) was better than ARC ٤١٩ ($R_{٢}$).

Table ٣: Effect of rhizobia inoculation on number and weight of nodules/root, seed yield/plant, ١٠٠- Seed weight and seed yield (ard/fed.) at New Valley and Mallawy, ٢٠٠٩/٢٠١٠ and ٢٠١٠/٢٠١١ seasons.

location	season	Rhizobia	No. of nodules/root/plant	Weight of nodules (g/plant	Seed yield/plant	١٠٠-seed weight (g)	Seed yield (ard/fed)
New valley	٢٠٠٩/٢٠١٠	$R_{١}$	٢٧.٤٧	٠.٢٦٠	٢٤.٢٤	٣٧.٥٨	٥.٦١
		$R_{٢}$	٢٤.٢٢	٠.١٩٥	٢٢.٧٨	٣٥.١١	٥.١٨
		LSD$_{٠.٠٥}$	١.١٧	٠.٠١٥	٠.٨٨	٠.٦٤	٠.٠٥
	٢٠١٠/٢٠١١	$R_{١}$	٢٣.٠٤	٠.٣٠١	٢٤.٨٤	٣٦.٨٨	٨.٤٠
		$R_{٢}$	١٩.٨٥	٠.١٨٦	٢٢.٣٤	٣٥.٥١	٧.٥٩
		LSD$_{٠.٠٥}$	٢.١٩	٠.٠٣٠	١.٩٧	١.٢٧	٠.٣٠
Mallawy	٢٠٠٩/٢٠١٠	$R_{١}$	٢٩.٠٨	٠.٢٦٦	٢٦.٩٩	٣٣.٦٧	٦.٣٧
		$R_{٢}$	٢٥.٩٧	٠.٢١٢	٢٤.٧٠	٣١.٥٣	٦.٠٧
		LSD$_{٠.٠٥}$	١.٧٦	٠.٠٢٠	٠.٧٩	١.٣١	٠.٠٥
	٢٠١٠/٢٠١١	$R_{١}$	٢٩.٥٣	٠.٣٠	٢٤.٩٩	٣٤.٦٥	٦.٥٢
		$R_{٢}$	٢٨.٣١	٠.٢٨	٢٢.٨٨	٣٢.٤٨	٦.٥٣
		LSD$_{٠.٠٥}$	٠.٨٥	٠.٠١٢	١.٢٢	١.٨٩	NS

Legume inoculation by rhizobial strains to enhance naturally occurring biological nitrogen fixation (BNF) has been a common practice for more than a century. It is important issue in legume nodulation, that not change the natural biodiversity or have any impact on newly released strain, (Amarger ٢٠٠١ and Sessitsch *et al* ٢٠٠٢).

C: Zinc fertilization effect:

Data presented in Table ٤, revealed that number and weight of nodules per root, seed yield/plant, ١٠٠-seed weight and seed yield (ard./fed.), exhibited significant differences between Zn treatments.

The application of Zinc at rate of ٠.٦ g/kg seeds ($Zn_{٢}$) recorded the highest number of number of nodules in most cases. For dry weight of nodules the rate of ٠.٣٠ g Zinc/kg seeds was the best in most cases.

Table. ٤: Effect of zinc fertilization on number and weight of nodules/root, seed yield/plant, ١٠٠- Seed weight and seed yield (ard/fed.) at New Valley and Mallawy, ٢٠٠٩/٢٠١٠ and ٢٠١٠/٢٠١١ seasons.

location	season	Fertilization	No. of nodules/ root/plant	Weight of nodules (g)/plant	Seed yield/plant (g)	١٠٠-seed weight (g)	Seed yield (ard/fed)
New valley	٢٠٠٩/٢٠١٠	Zn ٠	٢١.٤٦	٠.١٩٧	١٩.٥٠	٣٤.٣٦	٤.٥٥
		Zn ١	٢٥.٦٣	٠.٢٥٣	٢٣.٨٥	٣٦.٨٤	٥.٣٩
		Zn ٢	٣٠.٤٦	٠.٢٣٤	٢٧.١٦	٣٧.٨٤	٨.١٠
		LSD٠.٠٥	١.٤٣	٠.٠٢	١.٠٧	٠.٧٨	٠.٠٧
	٢٠١٠/٢٠١١	Zn ٠	١٧.٢٨	٠.١٨٦	١٩.٢٠	٣٣.٠	٧.١٦
		Zn ١	١٨.١٧	٠.٢٤٨	٢٣.٩٢	٣٦.٩١	٨.٢٨
		Zn ٢	٢٨.٨٩	٠.٢٩٨	٢٧.٦٧	٣٨.٦٥	٨.٥٤
		LSD٠.٠٥	٤.٦٦	٠.٠٤٠	١.٦٢	١.١٣	٠.٢٠
Mallawy	٢٠٠٩/٢٠١٠	Zn ٠	٢٣.٨٨	٠.٢١٥	٢١.٨٦	٢٣.٤٧	٥.٨٨
		Zn ١	٢٩.١٣	٠.٢٥٥	٢٦.٢٠	٣٥.٤٩	٦.٣١
		Zn ٢	٢٩.٥٨	٠.٢٤٦	٢٩.٤٨	٣٨.٨٣	٦.٤٨
		LSD٠.٠٥	٢.١٥	٠.٠٢٤	٠.٩٦	١.١٢	٠.٠٦
	٢٠١٠/٢٠١١	Zn ٠	٢٧.٦٨	٠.٣٠	٢٠.١٧	٢٩.٤١	٦.٢١
		Zn ١	٣١.٢٣	٠.٣١	٢٤.٢١	٣٣.٧٣	٧.١٨
		Zn ٢	٢٧.٨٤	٠.٢٨	٢٧.٤٣	٣٧.٥٧	٦.١٨
		LSD٠.٠٥	١.٥٧	٠.٠٢	١.٠٨	٢.٤٠	٠.٠٤

A rate of ٠.٦ g Zinc/kg seeds ($Zn_{٢}$) recorded the highest estimates of seed yield/plant, ١٠٠-seed weight and seed yield (ard./fed.).

Zn contamination significantly affected nodules number and weight indicating that high soil Zn contents were highly detrimental for nodulation. Applying micro-nutrients seeded assist plant building huge root structure since it helps in increasing root growth and all vegetative characters, Coleman (١٩٩٢). In addition, Sprent and Bradford, (١٩٧٧) suggested free living micro-organism do contribute to the pool of fixed nitrogen in agricultural systems, the legume-Rhizobium symbiosis is the more important source. The amount of nodule formed depends on many factors, such as the effectiveness of Rhizobium strain and the genetics of host plant. These findings revealed the importance of applying micro-nutrient coating on seed as an achievement led to overcome the poor soils problems of low soil fertility and low fertilizers use efficiency. Similar trend was reported by Gangwar and Singh (١٩٨٦) and Hegazy*et al* (١٩٩٣).

Interaction effects:

***Genotypes x rhizobia interaction:**

The interaction effect between genotypes and rhizobia at two locations was significant for number and weight of nodules per root(g) except the second season at New Valley.

Table ٥: Interaction effect between genotypes and rhizobia on No. and weight of nodules/root, at New Valley ٢٠٠٩/٢٠١٠ and ٢٠١٠/٢٠١١ seasons.

Season ٢٠٠٩/٢٠١٠				
Characters	No. of nodules/root		Weight of nodules (g)	
Rhizobia	$R_{١}$	$R_{٢}$	$R_{١}$	$R_{٢}$
Genotypes				
Giza ١	٢٩.٩٢	٢٨.٩٢	٠.٣٠٣	٠.٢٠٣
Giza ٢	٢٩.٥٨	٢٧.٠٠	٠.٢٤٢	٠.١٨٢
Imp. Dijon٢	٢٢.٩٢	١٩.٨٣	٠.٢٣٦	٠.٢٠٠
LSD$_{٠.٠٥}$	٢.٠٣		٠.٠٣	
Season ٢٠١٠/٢٠١١				
Giza ١	١٨.١١	١٩.٨٩	٠.٢٧٤	٠.١٥٣
Giza ٢	٣١.٨٩	٢٢.٥٦	٠.٣٥٩	٠.٢٢٢
Imp. Dijon٢	١٩.١١	١٧.١١	٠.٢٧٠	٠.١٨٣
LSD$_{٠.٠٥}$	٣.٧٨		NS	

Table ٦: Interaction effect between genotypes and rhizobia on no. and weight of nodules/root, at Mallawy ٢٠٠٩/٢٠١٠ and ٢٠١٠/٢٠١١ seasons.

Season ٢٠٠٩/٢٠١٠				
Characters	**No. of nodules/root**		**Weight of nodules (g)**	
Rhizobia / **Genotypes**	**R١**	**R٢**	**R١**	**R٢**
Giza ١	٣٣.٩٢	٢٧.٥٠	٠.٣٧١	٠.٢٥٣
Giza ٢	٢٨.٨٣	٢٥.٠٨	٠.٢٤٠	٠.١٩٨
Imp. Dijon ٢	٢٤.٥٠	٢٥.٣٣	٠.١٨٦	٠.١٨٤
LSD٠.٠٥	٣.٠٤		٠.٠٣	
Season ٢٠١٠/٢٠١١				
Giza ١	٣٣.٣٧	٣٠.٠٦	٠.٣٤٠	٠.٣٠
Giza ٢	٢٤.٧٩	٢٣.٦٨	٠.٢٥٠	٠.٢٤
Imp. Dijon ٢	٣٠.٤٣	٣١.١٩	٠.٣١٠	٠.٣٢
LSD٠.٠٥	١.٤٨		٠.٠٢	

Rhizobia x fertilization interaction:

Data recorded that the interaction effect between rhizobia and fertilization was significant for number of nodules per root at New Valley and Mallawy in both seasons, (Tables ٧ and ٨).

Table ٧: Interaction effect between rhizobia and zinc fertilization on No of nodules/root at New Valley, ٢٠٠٩/٢٠١٠ and ٢٠١٠/٢٠١١ seasons.

Season ٢٠٠٩/٢٠١٠			
Characters	**No. of nodules/root**		
Fertilization / **Rhizobia**	**Zn ٠**	**Zn ١**	**Zn ٢**
R ١	٢٣.١٧	٢٦.٢٥	٣٣.٠٠
R ٢	١٩.٧٥	٢٥.٠٠	٢٧.٩٢
LSD٠.٠٥	٢.٠٣		
Season ٢٠١٠/٢٠١١			
R ١	١٦.٤٤	١٨.٧٨	٣٣.٨٩
R ٢	١٨.١١	١٧.٥٦	٢٣.٨٩
LSD٠.٠٥	٦.٥٩		

Table ٨: Interaction effect between rhizobia and zinc fertilization on No. of nodules/root at Mallawy, ٢٠٠٩/٢٠١٠ and ٢٠١٠/٢٠١١ seasons.

Season ٢٠٠٩/٢٠١٠			
Characters	No. of nodules/root		
Fertilization / Rhizobia	Zn ٠	Zn ١	Zn ٢
R ١	٢٣.١٧	٢٦.٢٥	٣٣.٠٠
R ٢	١٩.٧٥	٢٥.٠٠	٢٧.٩٢
LSD٠.٠٥	٢.٠٣		
Season ٢٠١٠/٢٠١١			
R ١	١٦.٤٤	١٨.٧٨	٣٣.٨٩
R ٢	١٨.١١	١٧.٥٦	٢٣.٨٩
LSD٠.٠٥	٦.٥٩		

CONCLUSION

It could be concluded that, the best strain for crop and genotype should be selected for location because there is a specialization for rhizobia while, it can be an important issue in legume nodulation, neither change in the natural biodiversity nor the short and long-term impact on newly released strain is usually known. The amount of nodule formed depends on many factors, such as the effectiveness of Rhizobium strain and the genetics of host plant. Zinc is an important micronutrient essential for plant growth and development. The soil in dry regions is often poor in plant-available Zn.

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استجابة بعض التراكيب الوراثية من الترمس للتلقيح البكتيرى والتسميد بالزنك

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أجريت هذه التجربة في مزرعة كل من محطتي البحوث الزراعية بكل من الوادي الجديد وملوي، لدراسة تأثير سلالتين من اللقاح البكتيري هما ARC ٤٠٩ (R_1) و ARC ٤١٩ (R_2) تحت ثلاث مستويات من التسميد بعنصر الزنك في صورة مخلبية ١٤% (٠.٠٠، ٠.٣٠ و ٠.٦٠ جم زنك/ كجم بذور) عن طريق إضافته بطريقة تغليف البذرة وذلك لثلاث تراكيب وراثية من الترمس هي جيزة ١، جيزة ٢ وديجون ٢ محسن، خلال موسمي ٢٠٠٩/٢٠١٠ و ٢٠١٠/٢٠١١. وكان تصميم هذه الدراسة عبارة عن قطع منشقة مرتين حيث وضعت التراكيب الوراثية من الترمس في القطع الرئيسية والسلالات البكتيرية في القطع الشقية الأولى ومعاملات الزنك في القطع الشقية الثانية، في ثلاث مكررات.

وكانت هناك اختلافات كبيرة وفروق معنوية بين التراكيب الوراثية في كل من الوادي الجديد وملوي من حيث الصفات المدروسة وهى عدد ووزن العقد البكتيرية لكل جذر، محصول النبات ومحصول الفدان بالأردب. وكان تأثير السلالات البكتيرية واضح حيث

كانت هناك اختلافات معنوية وكانت السلالة البكتيرية الأولى ARC ٤٠٩ هي الأفضل في الموسمين لكلا الموقعين لجميع الصفات. بالنسبة لتأثير التسميد بعنصر الزنك دلت النتائج أن هناك فروق معنوية في كل من عدد العقد البكتيرية للجذر وكان أفضل مستوى للتسميد هو ٠.٦٠ جم زنك/كجم بذور في الوادي الجديد في الموسمين الأول والثاني، وكان نفس الاتجاه في ملوي للموسم الأول ولكن في الموسم الثاني كان معدل التسميد ٠.٣٠ هو الأفضل لصفات محصول النبات ووزن ١٠٠– بذرة. وأثر التسميد بشكل ملحوظ في صفات وزن ١٠٠ بذرة ومحصول الفدان. ويمكن أن نستنتج من هذه الدراسة أنه يجب اختيار أفضل سلالة بكتيرية متخصصة حسب المحصول لإنتاج أعلى عائد من المحصول واختيار أنسب صنف (تركيب وراثي) لكل منطقة.