

# BNHC E-MAGAZINE

**Introducing a convenient way!** *Earn your diploma online with one of the most comprehensive study programs available in social network*



**BioNatural Healing  
College**

## **Online 5 Diplomas**

*Offers a dynamic quality education to change and improve your quality of life by offering online education In convenient way.*



***FIND YOUR KEY  
TO SUCCESS!***

# Contents

- **Message:** from the President of BNHC
- **BNHC Directory: Board of Directors:** Dr. Nadir Sidiqi Ph.D., Mrs. Aziza Sidiqi, Mr. Zalmi Gulzarzada, Mr. Ghaus Siddiqi, Mr. Naveed Siddiqi
- **Staff & Faculty:** Mr. Shareef Karim, Mr. Wais Siddiqi, Prof. Rosalie Stafford, Dr. Muhammed Adil, Dr. Nadir Sidiqi Ph.D., Dr. Tanveer Alam, and Dr. Vivek Sharma.
- **Learning:**
- **BioNatural Healing**
- Medicinal plants, Nutrition, Health, Diet, Body, Mind, Spirit, Sleep, Exercise and related issues.
- **Science Research:**
- Agriculture, Environment, Public Health, Technology
- **Innovation, Educational Announcement (Conference, Workshop):**
- **BNHC News & Advertisements:**
- **About US:** Mission, Vision
- **Contact US:**
- **Email:** [info@bionaturalhealingcollege.org](mailto:info@bionaturalhealingcollege.org)
- **Phone:** (909) 242-6342 P.O. Box 218 La Verne, California 91750 USA.
- [BioNatural Healing College.org](http://BioNaturalHealingCollege.org)

# Message: from the President of BioNatural Healing College (BNHC)



Greetings!

First and foremost, I am extremely thankful to Almighty God for granting me this opportunity to present the BioNatural Healing College (BNHC), BNHC E-Magazine to our dear readers. Also, I would like to thank you all, especially the dear readers who send us their valuable feedback and support. The information in this magazine is solely for educational purposes.

We hope this BNHC- E-Magazine will be useful to you based on the contribution and dedication of many other respected researchers and colleagues around the globe. Thanking and wish you all the best health and prosperous life.

Best regards,

Dr. Nadir Sidiqi Ph.D.



# BioNatural Healing College

## **BioNatural Healing College Stands on Seven Core Pillar Foundations as follows:**

1. All living organisms are made from the water this beautiful connection, connects us to praise the Creator of Creation for the provision of feeding, fueling, and healing to humanity.
2. No harm to public health and environmental health (Biodiversity) including pollinators, surface water, groundwater, soil, and air.
3. A series of complex chains involved with food production from the field to the mouth of the human body desperately needs scientific research to maximize healthy nutritionally food production and end malnutrition and food insecurity.
4. Harmful pests such as insects, and pathogens causing to human and plant health and loss of economic problems. BioNatural chemicals from plants, microorganisms, and ocean-living organisms exist and need further research to discover along with safety to utilize for the health improvement of humans as well as BioNatural Pest Management (insects, fungi, bacteria, various, nematodes, weeds, rodents, etc.).
5. Listen, love, appreciate, and respect with deep conscience and subconscious the connection between the genes of your body and beautifully ecologically in sense of feeling, feeding, fueling, and healing.
6. The brilliant human mind can irrigate with balance drinking clean water as a whole-body system to detoxify the toxicant from their body systems as well as to detoxify the soil, water, and environment from harmful chemicals, particularly pesticides through collaboration, and dedication from the individual, family, community, and scientific community locally and globally.
7. BioNatural Healing College provides a high-quality science base foundation through online education to fit and accommodate the needs of each prospective student for the sustainability and prosperity of his or her own, family, community, and humanity.

# Chemical Fertilizers and Rhizobia Inoculants Effects on Soybean Yield and Yield Components

- Wakil Ahmad Sarhadi<sup>1</sup>, Wahida Yosofzai<sup>2</sup>, Mohammad Hakim Osmani<sup>1</sup>, Shamsruhman Shams<sup>3</sup>, Kim Tungate<sup>5</sup>, Mohammad Nadir Sidiqi<sup>6</sup> and Steven Kwon<sup>4</sup>
- <sup>1</sup>Department of Agronomy, Agriculture Faculty of Kabul University, Jamalmina Kartai-Sakhi. [sarhadi100@gmail.com](mailto:sarhadi100@gmail.com), [osmani.hakimi@yahoo.com](mailto:osmani.hakimi@yahoo.com)
- <sup>2</sup> Department of Organic Chemistry, Chemistry Faculty of Kabul University. [yusofzaiw@yahoo.com](mailto:yusofzaiw@yahoo.com)
- <sup>3</sup>International Center for Agricultural Research in the Dry Areas (ICARDA) Baharistan, Kabul City, Kabul, Afghanistan. [Shams.fda@gmail.com](mailto:Shams.fda@gmail.com)
- <sup>4</sup>Nutrition Education International 2500 East Foothill Blvd., Suite 407 Pasadena, CA 91107, USA. [Steven.kwon@neifoundation.org](mailto:Steven.kwon@neifoundation.org)
- <sup>5</sup>Soils and Crops Department University of Mount Olive, USA, email address: [unvendi1@gmail.com](mailto:unvendi1@gmail.com)
- <sup>6</sup> BioNatural Healing College (BNHC) P.O. Box 218, La Verne California 91750

## Abstract:

Soybean (*Glycine max* L.) has been a significant source of plant-origin proteins for both the livestock feed and human industries for many years. The soybean yield is low in smallholder farms in Afghanistan. The objective of this study was to examine the impact of DAP, nitrogen fertilizer, and Rhizobia on soybean yield and yield components performance. To achieve this objective, field experiments were conducted, using a randomized complete block design, with three replications, different levels of fertilizers, inoculants, and control as well. Soybean responded remarkably to the added nitrogen, and phosphorus sources fertilizers likewise biofertilizers. The crop characters were significantly influenced by these treatments.

Grain yields varied from 465 kg ha<sup>-1</sup> to 2532.8 kg ha<sup>-1</sup> in control treatment to 595 kg ha<sup>-1</sup>. Analysis of variance was applied to find the effects of different levels of DAP, N, and Rhizobia in yield and yield components of soybean. The results revealed that there were no significant differences in pod length, pods per plant, seeds per pod, and 100 grain-weight at a 5% level. The result of yield showed a significant difference at the 1% level. Based on the results a positive correlation (0.15366) was between 100 grains weight and grain yield. There was a significant difference in days to flowering and plant height among treatments, the longest days to flowering were detected in Rhizobia treatments as well as the shortest days to flowering in DAP treatments. The amount of chlorophyll concentration was measured using SPAD 502, there was no significant difference among treatments. It ranged from 2.67 to 3 mg in all treatments. Cluster analysis using UPGAM was applied to determine the effects of different types of fertilizers on the soybean agronomic relationship. Based on this analysis all treatments were classified into three groups. This study's novelty is using rhizobia in Afghanistan.

**Keywords:** Fertilizers, Inoculation, SPAD – 502, Yield, Yield Components, Chlorophyll Concentration, Soybean

**Introduction:** Soybean (*Glycine max*) is well known as a ‘miracle crop’ with over 40 % protein and 20 % oil, originating in China. As early as 2853 BC, the Emperor Sheng-Nung of China named it as one of the five sacred seeds. Thus, soybean has been cultivated in China for more than 4,000 years. It is believed that with the development of sea and land trades, soybean moved out of China to nearby countries such as Burma (Myanmar), Japan, India, Indonesia, Malaysia, Nepal, the Philippines, Thailand, and Vietnam between the first century AD and 1100 AD. Soybean is grown in more than 50 countries and is the leading oilseed crop produced and consumed worldwide (Wilcox, 2004). Soybean has now become the largest source of vegetable oil and protein in the world and its large-scale cultivation is concentrated in a few countries such as Argentina, Brazil, Canada, China, India, Paraguay, and the USA which together produce about 96 percent of the world's, 189 million tons annual soybean production.

BioNatural Healing College

Several studies on N in soybean-based systems reported that N removal at harvest may exceed biological fixation (Harper et al., 1989; Peoples & Craswell, 1992; Vanotti & Bundy, 1995). The combination of high rates of N removal with a potential reduction of biological N fixation due to soil compaction may make it necessary to balance N, either through N fertilizer application or by enhancing nodulation and N fixation. Most studies on the effect of fertilizer-N on soybean growth and N fixation by rhizobium conducted elsewhere concluded that fertilization reduces N fixation through a reduction in the number, weight, and activity of nodules (Starling et al., 1998; Chen et al., 1992). Coating soybean seeds with rhizobial inoculants has been suggested as a way to improve N fixation but the success of inoculation was found to be highly variable (Peoples & Craswell, 1992). Starter N increased caused N accumulation in plants but seed yields usually remained unchanged (Salvagiotti et al., 2008).

Poor nodulation and variable response to inoculation are mainly attributed to the intrinsic characteristics of the host plant (Michiels et al., 1998). As a result, the application of high amounts of inorganic-nitrogen fertilizers is becoming a common practice that has detrimental environmental consequences (Salton et al., 2008). Biological nitrogen fixation reduces the costs of production. The use of inoculants as alternatives to N fertilizer avoids problems of contamination of water resources from leaching and runoff of excess fertilizer. Utilizing biological nitrogen fixation (BNF) is part of responsible natural resource management. Legume inoculants do not require high levels of energy for their production or distribution. Application on the seed is simple compared to spreading fertilizer on the field.

Inoculants increase legume crop yields in many areas. Biological Nitrogen Fixation often improves the quality of dietary protein of legume seed even when yield increases are not detected. Through practices such as green manuring, crop rotations, and alley cropping, N-fixing legumes can increase soil fertility, permeability, and organic matter to benefit non-legume crops. Using BNF is part of the wise management of agricultural systems. The economic, environmental, and agronomic advantages of BNF make it a cornerstone of sustainable agricultural systems. Grain yields varied from 1.0 t ha<sup>-1</sup> to 1.7 t ha<sup>-1</sup> in unamended control plots to 4.8 t ha<sup>-1</sup> for common bean and 3.8 t ha<sup>-1</sup> for soybean in inoculated plots with both P and manure addition (Rurangwa et al., 2018). Legumes comprise the most important plant families in agriculture. Many soils do not have sufficient numbers of appropriate rhizobia for maximum BNF. Rhizobia inoculants and legume crops must be properly matched.

There are several methods of inoculating legumes. Inoculants require some special care to maintain their Viability Although BNF is a natural process, many soils do not have sufficient numbers of appropriate rhizobia for effective symbiosis (Denwar et al., 2012). Inoculating legume crops with compatible rhizobia ensures maximal BNF. Inoculation is especially important when introducing new legumes to an area (Dobbelaere et al., 2003; Zhang et al., 1997). The main objective of this research was to compare different levels of Urea and DAP including Rhizobia treatments and their effects on soybean yield and yield components.

**Materials and Methods:** A variety of (Stine3400 - 2) was used as plant material. Different levels of chemical fertilizers (Urea fertilizer and DAP), and biological fertilizers (Rhizobia) were used to evaluate the effects of these fertilizers on yield and yield components of soybean. Inoculant and DAP were used at cultivation time, and N fertilizer was applied at different stages of plant growth.

**Experimental site:** Field trials were established in the experimental farm of the Agriculture Faculty of Kabul University (34 °N 69°E) in 2016 and 2017.

The soil's physical and chemical properties were tested. A randomized complete block design was used with three replications and 36 plots. The area for each plot was prepared as 3 x 2 m (6 m<sup>2</sup>), and the space between rows and plants was considered 40 cm and 20 cm, respectively.

Germination tests were applied to find the germination capacity of soybean seeds, the result of the germination test of this cultivar was more than 80 %). The seeds were directly planted in the field.

A Vernier clipper instrument was used to measure the length of the pod and seed. SPAD (Soil Plant Analysis Development) was used to measure the amount of N in the leaves. Protein and oil analysis:

DK Series Kjeldahl Apparatus Made in Italy (DKL 8 (8-position with 250 ml tubes, Ø 42 mm) was used to analyze the percentage of protein and oil of soybean (Fig 1). Statistical Tool for Agricultural Research (STAR), Version 2.0.1, January 2014 was used to analyze the data.

### **Results and Discussion: Yield and yield components evaluation.**

Seed is the starting point of agriculture. Hence, the seeds were tested for percentage of germination and the result of germination was more than 80 %. Yield is one of the main objectives for researchers and farmers. All efforts are accomplished for the quantity and quality of products. Therefore, yield and yield components were measured and analyzed in the present research. Pod length plays a key role in the number of seeds per pod, as longer pods produce much more seeds than shorter ones. In using different levels of inoculants, exhibited longer pod length (more than 42 mm) (Tab 1). The number of pods per plant is also one of the important yield components. It means a large number of pods per plant performs a higher yield than less number of pods per plant.

In this research large number of seeds per plot was detected in DAP levels and 125 kg ha<sup>-1</sup> N as well. Hence, we can conclude that P is an important element in the somatic growth of crops. The number of seeds per plot was 72.87, 74.33, and 127.40 seeds per pod in 50 kg ha<sup>-1</sup> and 100 kg ha<sup>-1</sup> DAP, and 125 kg ha<sup>-1</sup> N respectively (Tab 1).

Seed number per pod, seed appearance, seed color, and seed quality plays a major role in yield per unit area. Thus, we decided to measure and analyze this useful parameter. Seeds per pod showed the same response to DAP, N, and Rhizobia (Tab 1).

South Dakota Agriculture Station reported a 4.97 t ha<sup>-1</sup> yield (Kleinjan et al., 2018), but in this research, the highest yield was obtained from the DAP application, which is 2.5 t ha<sup>-1</sup>. As was observed with early growth, no significant effect of either soybean cultivar or N treatment was present at EVS91 or WGS91, with an average yield of 34.9 and 31.4 bu/acre, respectively (Wood & Weaver, 1993). In this study, the highest yield using N fertilizer was 0.9 t ha<sup>-1</sup> that has a coincidence with the result of the above-mentioned authors (34.9 Bu acre<sup>-1</sup> is equal to 0.494 t ha<sup>-1</sup>). Ntambo et al (2017) reported 0.5 t ha<sup>-1</sup> of soybean yield using inoculant. When inoculated with Rhizobium sp. BARIRGm901, three of the four soybean genotypes tested (BARI soybean6 + R, MTD10 + R, and BGM02026 + R) showed significant increases ( $p \leq 0.05$ ) in seed yields (3.60, 3.08, and 3.22 t ha<sup>-1</sup>, respectively) compared with plants of other treatments genotypes (Alma et al., 2015; Albareda et al., 2015). But in this study using different rates of inoculant, we obtained 1.008 t ha<sup>-1</sup> of soybean yield which is two times higher than has been reported by Ntambo et al (2017).

100 grain-weight shows the healthiness of seeds. Because wrinkled seeds are softer and smoother seeds are heavier. The smooth seeds are healthy and their yield performance is also

There is a strong coincidence between 100 grains' weight and grain yield in this study. The different levels of DAP performed heavier grain weight as well as high yield than levels of N and Rhizobia. The yield of soybean in 125, 50, 75, and 100 kg ha<sup>-1</sup> levels of DAP was 2532.8, 2061.8, 1567.2, and 1238.3 kg ha<sup>-1</sup> respectively. The lowest yield was recognized in 120 kg h<sup>-1</sup> level of N per hectare (Tab 1).

Analysis of variance was applied to find the effects of different levels of DAP, N, and Rhizobia among yield and yield components of soybean. The results revealed that there were no significant differences in pod length, pod per plant, seed per pod, and 100-grain weight at a 5% level. The result of yield showed a significant difference at the 1% level (Tab 1). Based on the results a positive correlation (0.15366) was between 100 grains weight and grain yield. The least significant difference test was applied to compare different treatments and there was similarity and differences among treatments (Tab 1). Based on LSD 125, 50, and 75 kg ha<sup>-1</sup> levels of DAP were different from the others. The coefficient of variation in pod per plant is larger but in the other parameters is lower than 20% and it shows the preciseness of the research (Tab 1). Control exhibited the lowest yield (596 kg ha<sup>-1</sup>) than DAP, N, and Rhizobia treatments (Tab 1).

**Agronomic characters measurement and analysis:** Agronomic characters play a useful role in increasing crop yield. Days to flowering, nitrogen amount, plant height, and branch per plant were measured and analyzed in this research. Based on the results, days to flowering were earlier in DAP treatments than in N treatment and N treatments earlier than Rhizobia treatments, respectively. Days to flowering in DAP different levels ranged from 65.33 – 70 days, in nitrogen different levels ranged from 67.33 – 70.67 days and in Rhizobia ranged from 70 – 73.33 days.

Analysis of variance (ANOVA) was also applied to statistically compare the differences; the results of ANOVA were shown that there is a significant difference among treatments at 1% level. According to the least significant difference test (LSD), Rhizobia treatments exhibited later flowering performance than DAP and N treatments (Tab 2). We can conclude that it is the effect of N, which has been fixed by inoculants. Days to flowering adjustment are one of the important factors in the breeding program as well as diseases and drought escape factors.

SPAD 502 chlorophyll meter made in Japan was used to measure chlorophyll concentration, in the soybean plant. The application of this instrument helped the group to record chlorophyll concentration in different treatments. The results showed that a high level of chlorophyll was recorded in DAP and Rhizobia treatments than in N treatments. These results might be a physiological expression between soil and atmospheric N. while the amount of N is low in the soil, chlorophyll concentration increases. Results of ANOVA revealed that there is no significant difference among treatments in chlorophyll concentration of different treatments (Tab 2).

Plant height is one of the key traits for obtaining high yield. Plant height has also been focused on for measurement and analysis. The data were regularly collected, and ANOVA was applied to determine the differences among different levels of nutrients, which are important for plant growth. The outcome of ANOVA indicated that there is a significant difference among DAP, N, and Rhizobia levels at 1% level. The least significant difference test LSD has also been applied and the results exhibited that the treatments were classified into different categories via this method (Tab 2).

Desirable branching performs high yield, which is the main objective of researchers, specialists, and farmers as well. The branching of soybean was measured in this study. Apparently, we can see some differences, but statistically, there is no significant difference among treatments in the branching of the soybean plant (Tab 2).

## **Cluster analysis**

The term *cluster analysis* (first used by Tryon, 1939) encompasses a number of different [algorithms](#) and methods for grouping objects of similar kinds into respective categories. The *EM* algorithm for clustering is described in detail by Witten and Frank (2001).

Cluster analysis using UPGAM was applied to determine the effects of different types of fertilizers on the soybean agronomic relationship. Tree Diagram for 12 Variables Weighted pair-group average Euclidean distances were used to detect the relationship among 12 treatments, which were applied in this research. Based on the cluster results these treatments were classified into three main groups and each main group was divided into some subgroups.

Main group (I) consisted of 50 and 75 kg ha<sup>-1</sup> DAP, these variables exhibited a similar effect on soybean different parameters. Main group (II) consisted of 0.7905 and 0.5270 kg/ha of inoculant, 120 and 125 kg/ha N, and 0 levels (control), these variables had also the same effect on soybean growth. Main group (III) consisted of 130 and 135 kg/ha N, 0.2635 kg/ha inoculant, and 100 and 125 kg/ha DAP, these variables, classified in the same class, so performed the same expression on soybean life from different points of view (Fig 2). According to this cluster group, we can conclude that the treatments under the certain group had similar effects on yield, yield components, and agronomic characters.

## **Protein and Oil percentage analysis**

Based on laboratory results using DKL 8 (8-position with 250 ml tubes, Ø 42 mm) instrument, the highest level of protein was detected in control and 3X Rhizobia treatments (26.03 & 25.71 % respectively), and the lowest level of protein has been detected in 135 kg ha<sup>-1</sup> Urea treatment (22.9 %) (Fig 3). The oil percentage has also been analyzed and based on the results, the highest level of oil was recognized in 75 kg ha<sup>-1</sup> DAP treatment (19.08 %), and the lowest level was found in 125 kg ha<sup>-1</sup> DAP treatment (15.35 %). Mainly there is no big difference in protein and Oil among treatments using chemical and biological fertilizers.

## **Economic Return**

The higher cost of cultivation under inoculant rhizobium treatments (US \$. 3504, 2450 & 1396 ha<sup>-1</sup>) was because of the highest price of inoculant rhizobium (US \$. 4 g<sup>-1</sup>).

Maximum net return was obtained from 125 and 50 kg-DAP ha<sup>-1</sup> in the value of (US \$.1377.07 – 1243.33 ha<sup>-1</sup>). As medium NR was obtained from treatments 75,100 DAP ha<sup>-1</sup> and 100 Urea ha<sup>-1</sup> ranging from (US \$. 973.60, 812.40, 716.93 ha<sup>-1</sup>) and the lowest NR ranging from (US \$. 528.40, 474.53, 440.13, 276.93 ha<sup>-1</sup>) was obtained from treatments 250 Urea, control, 200 Urea and 150 Urea ha<sup>-1</sup> respectively (Tab 3). The economic analysis revealed that the highest net benefit of (US \$.1377.07 ha<sup>-1</sup>) was obtained from the application of 125 kg ha<sup>-1</sup> DAP fertilizer whereas the rhizobium treatments gave the negative net returns (US \$. -2406.67, -1453.73, -431.47 ha<sup>-1</sup>) (Tab 3). Therefore, with an economic basis, the application of 125kg DAP ha<sup>-1</sup>, 50 kg DAP ha<sup>-1</sup>, and in the case of Urea 100 kg ha<sup>-1</sup> on soybean would be recommended in Kabul province of Afghanistan.

## Conclusion

The Brady rhizobia used in this study was introduced by Nutrition and Education International (NEI) from the United States of America. It was the first time that *Rhizobium* sp was used in this study in Afghanistan. This study was also a comparative study with chemical fertilizers to find the effect of this biological fertilizer on the yield and quality of soybean in Afghanistan. Based on research the highest yield was obtained from DAP treatment. South Dakota Agriculture Station reported a 4.97 t ha<sup>-1</sup> yield (Kleinjan et al., 2018), but in this research, the highest yield was obtained from the DAP application, which is 2.5 t ha<sup>-1</sup>. As was observed with early growth, no significant effect of either soybean cultivar or N treatment was present at EVS91 or WGS91, with an average yield of 34.9 and 31.4 bu/acre, or (949.82 kg acre<sup>-1</sup>) and (854.57 kg acre<sup>-1</sup>, respectively (Wood & Weaver, 1993). In this study, the highest yield using N fertilizer was 0.9 t ha<sup>-1</sup>, coinciding with the result of the above-mentioned authors (34.9 Bu acre<sup>-1</sup> is equal to 0.494 t ha<sup>-1</sup>). Ntambo et al (2017) reported 0.5 t ha<sup>-1</sup> of soybean yield using inoculant. When inoculated with *Rhizobium* sp. BARIRGm901, three of the four soybean genotypes tested (BARI soybean6 + R, MTD10 + R, and BGM02026 + R) showed significant increases ( $p \leq 0.05$ ) in seed yields (3.60, 3.08, and 3.22 t ha<sup>-1</sup>, respectively) compared with plants of other treatments genotypes (Alma et al., 2015; Albareda et al., 2015). But in this study using different rates of inoculant, we obtained 1.008 t ha<sup>-1</sup> of soybean yield which is two times higher than has been reported by Ntambo et al (2017). However, the results of this research are recommendable to farmers, but further research is needed. Because it was the first research using Rhizobia inoculants in Afghanistan, this study's novelty is at this point.

## Acknowledgment

We would like to express our sincere thanks to NEI for providing a grant for this research, and likewise experimental farm staff for their contribution in planting, growing period, and harvesting.

## Discloser statement

The authors declare that they have no conflict of interest.

## References

Alam F, Bhuiyan M, Alam SS, Waghmode, TR, Kim PJ, Lee YB (2015) Effect of Rhizobium sp. BARIRGm901 inoculation on nodulation, nitrogen fixation and yield of soybean (*Glycine max*) genotypes in gray terrace soil. *Bioscience, Biotechnology and Biochemistry* **10**: 1660-1668.

Albareda M, Rodríguez-Navarro DN, Temprano FJ (2009) Soybean inoculation: Dose, N fertilizer supplementation and rhizobia persistence in soil. *Field Crops Research*. **4**: 352-356.

Denwar NN, Buah SS (2012) Response of soybean to fertilizer and Rhizobium inoculation in the NR and UWR. The CSIR-Savanna Agricultural Research Institute, Ghana. 1 -2.

Dashti N, Zhang F, Hynes R, Smith DL, (1998) Plant growth promoting rhizobacteria accelerate nodulation and increase nitrogen fixation activity by field grown soybean [*Glycine max* (L.) Merr.] under short season conditions. *Plant Soil*. 200:205-213.

Harper LA, Giddens JE, Langdale GW and Sharpe, R.R. 1989. Environmental effects on nitrogen dynamics in soybean under conservation and clean tillage systems. *Agron. J.* 81:623-631.

Kleinjan J, Kirby, K and Hawks, S .2018. Soybean Variety Trial Results Bancroft. South Dakota State University, Agronomy, Horticulture & Plant Science Department.

Ntambo MS, Isaac SC, Aid TS, Hafeez T .A, Rahat S, Consolatha C, Larry. 2017. The effect of rhizobium inoculation with nitrogen fertilizer on growth and yield of soybeans (*Glycine max* L.). *IJB*. 10: 162 – 172.

Peoples MB, Craswell E.T. 1992. Biological nitrogen fixation: Investments, expectations and actual contributions to agriculture. *Plant Soil*. 141:13-39.

Raper CD, Kramer P.J. 1987. Stress physiology. In: WILCOX, J.R., ed. *Soybeans: Improvement, production, and uses*. 2. ed. Madison, ASA/CSSA/SSSA. P.589- 641.

Rurangwa E, Vanlauwe B, Giller, KE. 2018. Benefits of inoculation, P fertilizer and manure on yields of common bean and soybean also increase yield of subsequent maize. *Agric. Ecos & Envir. J.*, [261](#): 219-229.

Starling ME, Wood CW, Weaver DB. 1998. Starter nitrogen and growth habit effects on late-planted soybean. *Agron. J.* 90:658-662.

Slaton NA, DeLong RE, Shafe JR, Clark. Golden SB, Maschmann E. 2008. Soybean Response to Poultry Litter and Inorganic Fertilizer. *Arkansas Soil Fertility Studies*. 57 – 59.

Salvagiotti [E](#), Cassman [KG](#), Spech [JE](#), Walters [DT](#), Weiss [A](#), Dobermann [A](#). 2008. Nitrogen uptake, fixation and response to fertilizer N in soybeans. *Field crop research*. 108: 1 – 13.

Vanotti MB, Bundy LG. 1995. Soybean effects on soil nitrogen availability in crop rotation. *Agron. J.* 87:676-680.

Wood CW, Weaver DB. 1993. Nitrogen Fertilizer Effects on Soybean Growth, Yield, and Seed Composition. Dep. of Agronomy and Soils. 202 Funchess Hall. Auburn Univ., AL 36R49-5412; H.A. Torbert. USDA-ARS Grassland. Soil and Water Res. Lab., 808 E. Blackland Rd., Temple. TX 76502. *J. Prod. Agric.* 6:354-360.

## Table 1. Evaluation of DAP, Nitrogen, and Rhizobia treatment's effects on yield and yield components of soybean.

Pod Length (PL), Pod per Plant (PPP), Seed per Pod (SPP), 100 Grain Weight (100 GW), grain yield (GY), and Means in a column with the same letter are not significantly different \*, \*\* at P<

Treatment	PL (mm)	PPP	SPP	100 GW (g)	GY kg ha <sup>-1</sup>
125 DAP	39.16	66.93	3.00	11.23	2532.8 a
50 DAP	42.47	72.87	3.00	12.37	2061.1 b
75 DAP	40.58	55.47	2.67	12.27	1567.2 c
100 DAP	39.91	74.33	3.00	11.90	1238.3 d
125 N	41.18	127.40	3.00	12.37	900.6 ef
120 N	40.66	55.67	3.00	11.80	465 g
130 N	39.35	52.73	3.33	10.93	712.8 fg
135 N	39.11	53.07	3.00	10.90	1021.7 de
0 Control	41.91	41.27	3.33	12.03	595 g
0.2635 R (1X)	38.85	37.27	3.00	10.90	953.9 ef
0.527 R (2X)	42.09	54.87	3.00	11.33	903.3 ef
0.7905 R (3X)	42.37	58.60	3.33	10.63	1008.3 de
Mean	40.64	62.54	3.06	11.56	1163.3
F-test	ns	ns	ns	ns	**
SEM	1.11	17.19	0.23	0.62	94.9
SED	1.57	24.31	0.33	0.87	134.2
LSD (p= 0.05)	3.27	50.42	0.69	1.81	278.2
C.V	4.75	47.61	13.26	9.25	14.1

0.05 and P< 0.001, respectively, ns = Not significant, Di-Ammonium phosphate (DAP, Nitrogen (N), Rhizobia (R).

**Table 2. Analysis of the effects of DAP, N, and Rhizobia on agronomic traits of soybean.**

Treatments (Kg ha <sup>-1</sup> )	DTF	Chlorophyll concentration (mg)	PHT (cm)	BPP
125 DAP	68 bcd	39.00	58 a	3.80
50 DAP	65.33 a	41.00	65 a	5.27
75 DAP	66 ab	40.00	62 b	4.47
100 DAP	70 de	40.00	60 c	4.67
125 N	67.33abc	38.00	66 a	5.73
120 N	69.33 cde	38.00	47.3 g	3.33
130 N	70.67 e	38.00	53 e	3.47
135 N	68 bcd	39.47	50 f	4.07
0 Control	68 bcd	39.20	50 f	3.27
0.2635 R (1X)	73.67 f	40.00	51 f	4.13
0.527 R (2X)	73.33 f	41.00	57 d	4.40
0.7905 R (3X)	70.33 e	40.00	61 bc	4.87
Mean	69.17	39.47	0.68	4.29
F-test	**	ns	**	ns
SEM	0.75	0.74	56.69	0.72
SED	1.06	1.04	0.96	1.02
LSD (p= 0.05)	2.20	2.16	1.99	2.11
C.V	1.88	3.23	2.07	29.01

Days to Flowering (DTF), SPAD and plant height (PHT), Pod per Plant (PPP) , and Means in a column with the same letter are not significantly different \*, \*\* at P< 0.05 and P< 0.001, respectively; NS= Not significant, Di-Ammonium phosphate (DAP, Nitrogen (N), Rhizobia (R)).

**Table 3. Cost-benefit analysis of chemical and biological fertilizers application.**

Treatments	Cost of Cultivation (US \$/ha)	Gross Return (US \$/ha)	Net returns (US \$/ha)	Net returns per US \$ invested
T1	425.33	1802.40	1377.07	3.24
T2	375.33	1618.67	1243.33	3.31
T3	392.00	1365.60	973.60	2.48
T4	408.67	1221.07	812.40	1.99
T5	382.00	1098.93	716.93	1.88
T6	402.00	678.93	276.93	0.69
T7	422.00	862.13	440.13	1.04
T8	442.00	970.40	528.40	1.20
T9	342.00	816.53	474.53	1.39
T10	1396.00	964.53	-431.47	-0.31
T11	2450.00	996.27	-1453.73	-0.59
T12	3504.00	1097.33	-2406.67	-0.69

Fig 1. Tree diagram of different levels of DAP, N, and Rhizobia and their effects on soybean yield, yield components, and agronomic traits.

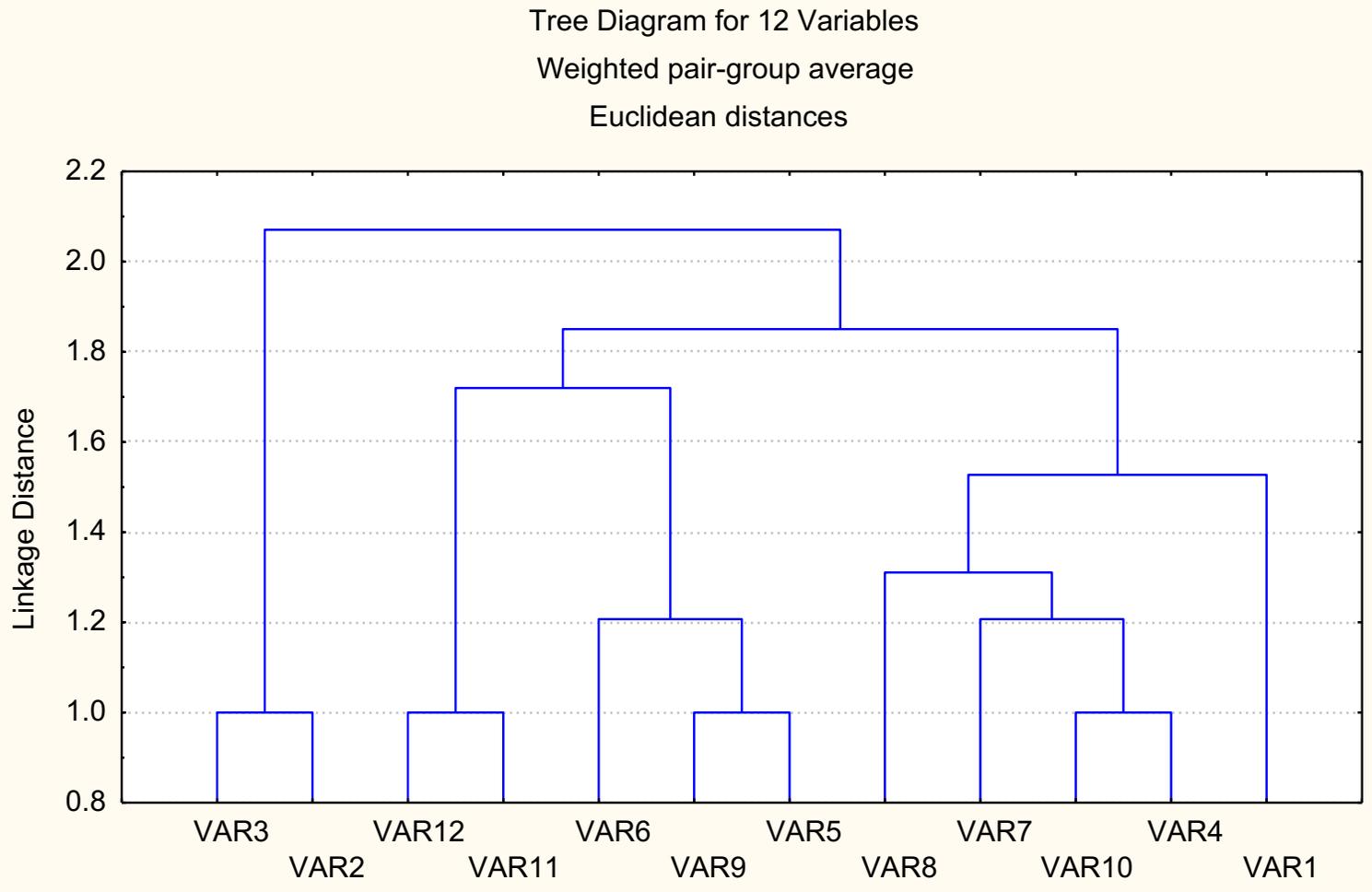
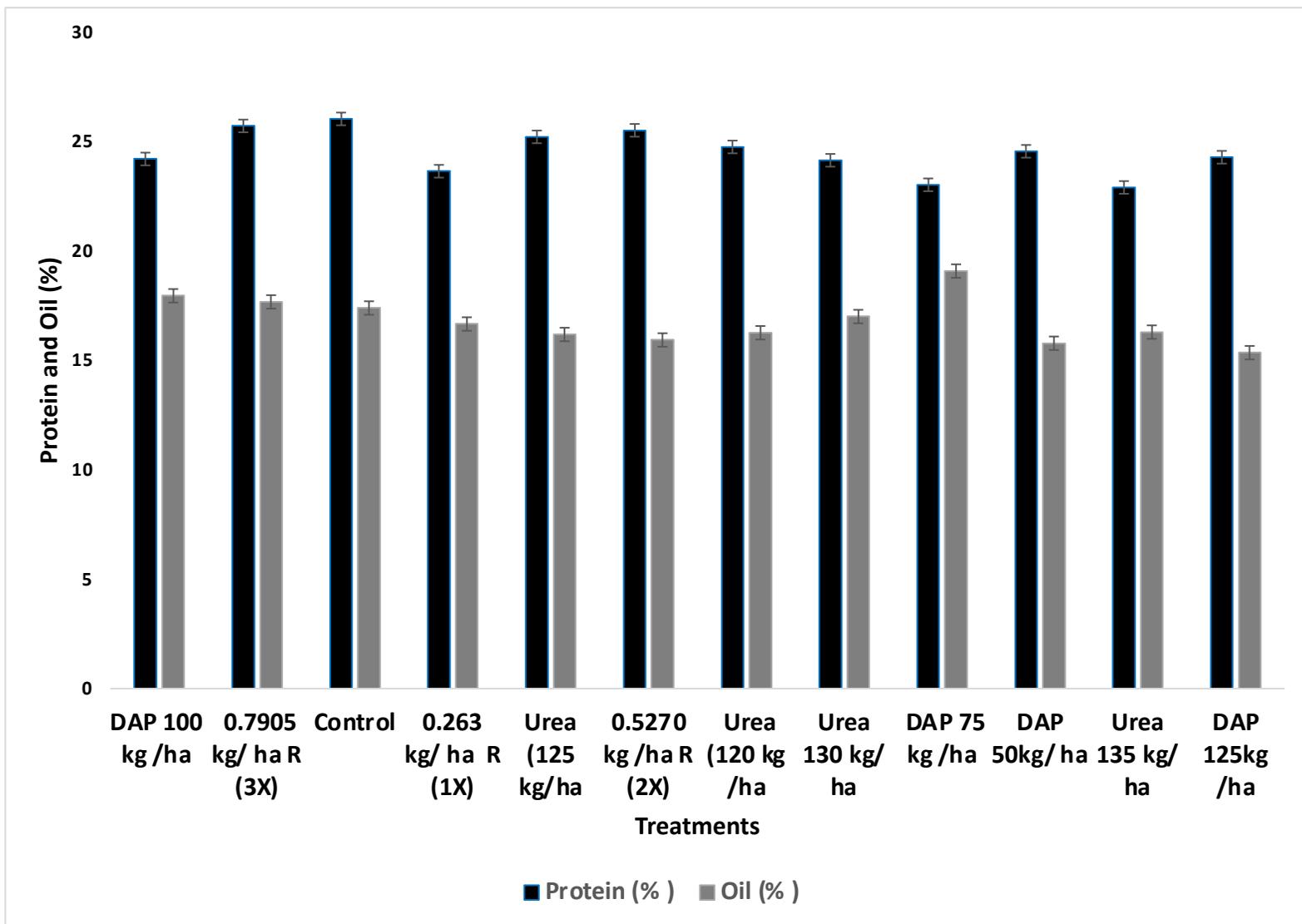


Fig 2. Effects of different levels of chemical and biological fertilizers on soybean Protein and Oil percentage.





# BioNatural Healing College

## **BioNatural Healing College (BNHC)**

**BNHC OFFERS ONLINE 5  
DIPLOMAS UNDER A  
QUALIFIED PROFESSOR  
(30 credits per diploma)**

- 1. Herbal Science &  
Master Herbalist**
- 2. Holistic Health  
Practitioner**
- 3. BioNatural Pest  
Management**
- 4. Nutrition & Brain  
Function**
- 5. BioNatural Health  
Practitioner**

## **BioNatural Healing College (BNHC) OFFERS CONTINUING EDUCATION**

**IN-PERSON SEMINARS  
AS WELL AS ONLINE 11-  
Hour Approved FOR  
CALIFORNIA  
DEPARTMENT OF  
PESTICIDE  
REGULATION**

**DATES: 4/26/23, 5/30/23,  
6/27/23, 7/27/23, 8/20/23,  
9/28/23, 10/26/23, 11/21/23,  
12/19/23**

**Location: Pomona,  
California**

**FOR MORE  
INFORMATION PLEASE  
CONTACT US: PH: 909-  
242-6342**

**CONTACT US: PH: 909-242-6342 OR  
EMAIL: [info@bionaturalhealingcollege.org](mailto:info@bionaturalhealingcollege.org)  
[www.bionaturalhealingcollege.org](http://www.bionaturalhealingcollege.org)**



# BioNatural Healing College

## **BIONATURAL HEALING COLLEGE (BNHC)**

### **ONLINE EDUCATION**

***LEARN, APPLY  
AND SHARE THE  
KNOWLEDGE TO  
THE BENEFIT OF  
HUMANITY.***

## **BIONATURAL HEALING COLLEGE (BNHC) ONLINE EDUCATION**

**Convenient to start at any  
time from your comfort  
zone.**

**Reasonable tuition fee with  
option plans available.**

**Contact Us: Ph: (909) 242-  
6342**

**Email:**

**[info@bionaturalhealingcollege.org](mailto:info@bionaturalhealingcollege.org)**

**[www.bionaturalhealingcollege.org](http://www.bionaturalhealingcollege.org)**

**CONTACT US: PH: 909-242-6342 OR**

**EMAIL: [info@bionaturalhealingcollege.org](mailto:info@bionaturalhealingcollege.org)**



**Mission:** BioNatural Healing College is a non-profit public benefit institution that has tax-exempt status under the Internal Revenue Service, Section 501(c)(3) of the United States of America. Our goal is to offer a high-quality education a diploma program as well as holistic health and nutrition conferences, seminars, workshop, and continuing education. The focus of these educational programs is to offer healing and holistic nutrition science through online distance learning. These dynamic online education programs will provide diverse adult learners throughout the world the experience of enhancing their quality of life, their health, and their happiness.

**Vision:** The faculty, staff and management team of BioNatural Healing College are passionately committed to providing the best teaching possible in this field. We seek to encourage, motivate and explain the importance of this field to prospective students so that they may make an informed decision regarding enrollment. We seek an ultimate goal of satisfaction for the student based on responsibility, commitment, respect, awareness and sustainable education for society.

**Accreditation and Recognition:** BioNatural Healing College is based in California. It is an institution that has the goal to deliver on- demand online distance learning around the globe. This education is of high quality and vocational in nature. BioNatural Healing College is a legal business entity that has been approved to operate by the State of California's Bureau for Private Postsecondary Education that set forth in the educational code. BioNatural Healing College is not accredited by the United States Department of Education. BioNatural Healing College is a member of the American Holistic Health Association (AHHA).

