Evaluation of some biodynamic applications on cotton, sesame and wheat under Egyptian conditions

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Presented in the International conference of "Plant nutrient management under stress conditions", National Research Center, Cairo, Egypt, November 2008.

1- Introduction

Biodynamic agriculture was the first ecological farming system to arise in response to commercial fertilizers and specialized agriculture after turn of last century; It is an advanced organic farming system that is gaining increased attention for its emphasis on food quality and soil health. In practice, the main difference between biodynamic agriculture and organic is the use of cosmic. rhythms and the use of so-called biodynamic preparations.

Cosmic rhythms mean that the light of the sun, moon, and planets influence plants in regular patterns. By recognizing the effect of each rhythm, such as planting by phases of the moon, farming operations could be timed to the advantage of the crops being raised. Thun developed what may be called the "Thun theory" whereby crops were differentiated into the four categories of root (e.g., potatoes, radish), leaf (e.g. lettuce, spinach) flower and fruit/seed (Thun 1991,1999 ,2001) Since her work was first published there have been supporters and detractors, popular and more rigorously considered who have made their own trails and evaluated her work. Kollerstrom and staudenmaier in 2001 reviewed both supportive and dismissive research and concluded that following careful re-analysis, the evidence demonstrated that the results confirmed the earlier findings that the sidereal rhythm does indeed effect germination and growth in the way described by Thun and biodynamic sowing and planting calendar. Various biodynamic calendars are published around the world based on Thun work. In such calendars planting and harvest times are suggested for optimal growth and quality development of the plant part affected. In the Egyptian Biodynamic Association (EBDA) the biodynamic calendar published annually by Maria Thun is used (Thun and Thun, 2005).

On the other hand, Biodynamic preparation are biological growth regulators made from fermented natural substances, under specific rhythms of the year, to improve soil and crop quality, numbered BD500 – BD 508 .The BD500 preparation (horn –manure) is made from cow manure and is used as a soil spray to stimulate root growth and humus formation. The BD501 preparation (horn-silica) is made from powdered quartz and applied as a foliar spray to stimulate and regulate growth. The next six preparations are BD 502 (yarrow blossoms), 503 (chamomile blossoms), 504 (stining nettle), 505 (Oak bark), 506 (Dandelion flowers), 507 (Valerian flowers) used for compost. Finally, there is BD preparation 508 which is prepared from the silica-rich horsetail plant and used as a foliar spray to suppress fungal diseases in plants (S.Diver 1999). The biodynamic farming association of New Zealand(2000) indicated that a 75 % increase of oxygen in the water after 1 hour of manually stirring the biodynamic preparation into the water and supported the hypothesis that water transfers information and described the scientific relevance of the theory that water keep the memory of dissolved substances.

The preparations are used in homeopathic quantities, meaning they produce an effect in extremely diluted amounts. Examination of 28 different experiment in Germany showed that the use of the biodynamic sprays increased crop yields (cereals and vegetables) where yields were low (Goldstein and W. Barber 2005). This so called "yield – balancing" effect could possibly be important for reducing financial risk for farmers, and it may indirectly due to enhanced soil quality and rooting. These regulators have been shown to have hormone-like effects on various crops grown (Goldstein, 1979, Goldestein and Koepf 1982, fritz,et al ., 1997)

The main objective of the present work is to evaluate the influence of three components of the biodynamic system on three crops cotton, sesame and wheat under Egyptian condition. The components are applying the biodynamic calendar and the use of preparations 500 and 501, i.e. timing the agriculture activities of the crops according to calendar schedule. The influence of each of the these components are studied separately or in combination with each other

2- Methods

2-1Handling of biodynamic preparations

Horn preparation was prepared by adding 200 gm of the preparation to 20 liter of water and stirred for an hour. This solution is sprayed in the afternoon on the soil after seed bed preparation. Each spraying of silica preparation was made by stirring of 2 grams of the preparation is mixed with 20 liter of water stirred for one hour and sprayed in the early morning on the crop.

2-1Cotton experiment 2005

Cotton is a fruit crop. The main objectives of this experiment is first to compare the influence of timing of the planting date between flower days T1 and fruit days T2 and second the influence of spraying horn preparation alone in fruit day T3, and third the effect of different silica applications (three and five times) i.e. the first three applications were sprayed before flowering stage ant the other two after flowering stage in comparison with the normal three sprayers. A complete randomized design was adopted; five treatments, four replicate each. Table (1) shows the treatments and its time of application. The days i.e. 7/5,……all fruit days but 12/5 is not fruit day

Table (1) Treatments and dates of applied operations

Treatment	Cultivation time	Horn application	Quartz application				
			1	2	3	4	5
T1:planting in flower day	12/5	-	-	-	-	-	-
T2:planting in fruit day	7 / 5	-	-	-	-	-	-
T3:planting in fruit day and horn application	7 / 5	7 / 5	-	-	-	-	-
T4:planting in fruit day ,horn and 3 quartz application	7 / 5	7 / 5	28/7	7/8	24/8	-	-
T5:planting in fruit day and five times quartz application	7 / 5	7 / 5	28/7	7/8	24/8	12/9	20/9

2-2 Sesame experiment 2005

This trial was carried out at El-Rah farm of Tuna El-Gable; El-Mania Gov. the farm is biodynamic for 10 years. The main aim of this experiment is to see the influences of

adapting the calendar. Sesame is a fruit crop i.e. (planting in fruit day) in combination of both BD500, and BD 501 preparation (T1), calendar with BD500 alone (T2) and calendar with BD501 in comparison to similar three other treatments T4, T5and T6 except planting is in none fruit days i.e. not following calendar . T7 is planting in fruit days with no preparations. A complete randomized design was adapted, treatments each of four replicates. Table (2) shows the treatments and its time of application, i.e. 17/5, 11/5, 11/7, 20/7 and 6/8 are fruit days while the other is non fruit days

Table (2) shows the exact timing for applying these treatments.

Treatment	Cultivation date	Horn	Quartz		
			No. 1	No. 2	No. 3
T1:Fruit days ,horn and quartz	17/5	17/5	11/7	20/7	6/8
T2:Fruit days and horn	17/5	17/5	-	-	-
T3:Fruit days and quartz	17/5	-	11/7	20/7	6/8
T4:Non fruit days ,horn and quartz	20/5	20/5	14/7	23/7	9/8
T5:non fruit days with horn	20/5	20/5	-	-	-
T6::non fruit days with quartz	20/5	-	14/7	23/7	9/8
T7: Control	20/5	-	-	-	-

2-3Wheat experiment 2004/2005

The experiment was carried out in Galevna area, Belbes district. The area is a biodynamic registered farm for 7 years. Soil bed preparation was carried out as normal; plowing twice and followed by leveling. Wheat was broadcasted at a rate of 60 kg/fed. Complete random design was used five treatments with four replications. Table (3) shows the various treatments and its application time

Table (3) Treatments and dates of applied operations

Treatment	Cultivation time	Horn application	Quartz application		
			1	2	3
T1: Control, planting in fruit days.	25/11	-	-	-	-
T2:Fruit days and horn	25/11	4/12	-	-	-
T3:Fruit days ,horn and 3 application of quartz for grain	25/11	4/12	13/12	22/2	31/12
T4:fruit days ,horn and 3 quartz application for maximum straw yield	25/11	4/12	19/1	27/1	6/2
T5:Planting in Fruit days and three quartz application in non fruit days	25/11	4/12	5/12	12/12	17/12

T1 Control, planting in fruit day

T2 to test the influence of panting in fruit days with BD500

T3 and T4 were designed to test the hypothesis made by Maria Thun (2005) that early application of BD501 increase grain yield where as at later stage increase straw yield

T5 to test the influence of BD501 sprayed in non fruit day in comparison to T3

3- Results

3-1 cotton trail

This trial data were collected four times during the season. Table (4) show the statistical analyses of data obtained during the vegetative stage of plant growth (27^{th} of July& 1^{st} of

Sep.) and maturity stage (3rd of October till the end of harvest. The results indicate the significance difference between treatments in both stages.

Table (4) Statistical analysis of the data on various treatments

Treatments	Growth stage					Maturity stage			
	Data at 27 of July			Data at first of Sept		Data at 3rd of Oct.		Data at 5th of December	
	Plant height	Height of first fruiting branches	No. of vegetative branches	No. of green boll/plant	Weight of green boll/plant	No. of fruiting branches	No. of bolls/ plant	Day Boll weight	Seed cotton yield/ ken/fed
T1	120.0c	7.66a	2.10d	16.44d	131.96d	14.41d	17.86d	2.64e	10.14e
T2	129.0b	7.53b	2.60c	18.32c	151.59c	15.00c	20.93c	2.72d	11.19d
T3	134.66a	7.40c	2.97b	19.19b	176.83b	15.83b	21.41c	2.83c	12.10c
T4	139.66a	7.30d	3.30a	21.49a	178.49b	16.08b	24.98b	2.92b	13.86b
T5	139.33a	7.33cd	3.33a	21.88a	180.83a	16.75a	29.91a	3.02a	14.92a
Mean	132.53	7.45	2.86	19.5	163.48	15.61	23.02	2.83	12.44
LSD at 0.05	5.548	0.084	0.168	1.035	2.809	0.56	1.142	0.049	0.059

T1: planting in flower day
T2: planting in fruit day
T3: planting in fruit day and horn application
T4: planting in fruit day, horn and 3 quartz application
T5: planting in fruit day and five times quartz application

3-1-1 Growth stage

Differences between T4 and T5 were not significant, because the two silica additional spraying were applied after the data collection.
But the difference was very clear between either of them and the other treatment. Data shows increase of 15, 46, 57, 30 and 35% for plant height, height of first fruiting stage, number of vegetative plants, number and weight of green bolls respectively for the combined effect in comparison to planting in flowering day T1. The influence of planting in fruit day (T2) shows an increase of 7, 23, 11 and 15% for same parameters respectively compared to planting in flowering day (T1). Height of the first fruiting branches gave negative value which indicates that the fruiting area increases with the application of the biodynamic calendar and preparations.

3-1-2 Maturity stage

The influence of planting in fruit day (T2) in comparison to plenty in flower day (T1) shows an increase of 4.6, 17 3, 17% respectively for no of fruiting branches, No. of bolls per plant, dry boll weight and seed cotton yield respectively. Horn application (T3) increased some parameters by 5, 19,7,10.8 respectively

Table (4) shows the clears and significant difference between T4 and T5. Number of fruiting branches, total number of bolls, average weight of boll, and actual harvest were increased by 16, 67, and 33% for T5 comparing to 11.6, 39, 7.4 and 23.9% for T4, both with respect to T1 respectively

3-2 Sesame trials

Table (5) shows the results of the statistical analyses of the data obtained. Fruit day's treatments T1, T2 and T3 gave significant difference in all measured parameters in comparison of non fruit day's treatment T4, T5 and T6. For example plant yield increased by 27, 9, and 16% comparing T1 by T4, T2 by T5 and T3 by T6 respectively i.e. an averaged of 17%. It is clear that combining horn and quartz in fruit days (T1) gave the best results. The figures of the control treatment T7 is the lowest values in all the measured parameters.

Table (5) statistical analyses of the data collected season (2005).

Treatments	Plant height (cm)	First pod height (cm)	Fruit area height (cm)	No. of pod	Plant yield (g)	Feddan yield (kg)
T1:Fruit days ,horn and quartz	260.53	69.18	191.28	166.05	21.59	832.57
T2:Fruit days and horn	239.35	79.13	160.22	146.60	17.19	758.30
T3:Fruit days and quartz	254.48	77.78	176.83	152.78	19.78	799.40
T4:Non fruit days ,horn and quartz	230.35	81.20	149.15	139.58	16.91	752.00
T5:non fruit days with horn	217.25	83.50	133.75	135.33	15.75	672.80
T6::non fruit days with quartz	230.25	82.85	147.38	133.80	16.92	716.75
T7: Control	215.00	79.38	135.63	133.08	16.22	652.50
LSD at 5%	10.72	9.70	7.05	7.13	1.05	43.40

The full package of biodynamic system (T1) gave an increase of 41, 24, 33 and 27% for fruiting area, number of pods, yield per plant and actual harvested yield per feddan respectively.

Adding each preparation separately in fruit days increased previous parameters by 18, 10, 5.9 and 16% for horn and 30, 14, 21and 22% for quartz respectively with respect to T7. In non-fruit days the difference were not that high.

Wheat 2004/2005

Table (6) shows the statistical analysis of the obtained data. Comparing T2 with T1 indicate that horn mist increase number of panicles, grain yield and straw yield by 16.6, 33.3 and 67% respectively

Table (6) Results of wheat trial

Treatment	No. of panicles	Corn yield g/m^2	Straw yield g/m^2
T1: Control, planting in fruit days.	331.93	496.53 e	614.37 e
T2:Fruit days and horn	386.80	662.07 b	1085.63 b
T3:Fruit days ,horn and 3 application of quartz for grain	425.70	792.37 a	993.07 c
T4:fruit days ,horn and 3 quartz application for maximum straw yield	365.27	604.17 c	1246.50 a
T5:Planting in Fruit days and three quartz application in non fruit days	334.03	534.70 d	875.00 d

Mean	368.75	617.97	962.91
L.S.D at 5%	NS	0.148	0.0188

Applying the full biodynamic package (T3) increased the three measured parameters by 28, 59 and 61% respectively. In T4 where the quartz preparation was sprayed three times but in later growth stages gave the highest yield of straw by lower yield of grain in comparison was carried out in early stages of plant growth. The results of T5 treatment where quartz is applied in non-fruit days gave slight increase in productivity.

4- Discussion and conclusion

The yield increase was 40, 27 and 59% for the three crops respectively, as a result of applying the three tested parameters i.e. timing the operations with the biodynamic calendar, applying BD500 and BD501. These results agree with the reported figures of Maria Thun (2003) which indicate that timing cultivation activities according to biodynamic calendar significantly increased crop yield by 11, 20, 44 and 83% for sunflower, canola, clover and strawberries respectively.

European research on the biodynamic preparations shows an affects on soil structure, root development, yield and crop quality. The influence of the timing the operation with the calendar alone increased yield by 17% for both cotton and sesame trails .The difference of the yield of the two crops between the full package and the calendar alone is the biodynamic preparation Applying horn preparation has increased yield by 27%, 46%, 7% and 13% for potato, onion, beans and cucumber. For same crops applying quartz preparation increased yield by 21, 20, 25 and 31 % respectively (M. Thun 2003)

De Vries (1988) reported a balanced development of grass in spring and a stimulation of grass growth in autumn after applying the field –spays 500 and 501. Von Mackesen (1994) studied the effects of the preparation on strawberries and reported a rich setting of a fruit, good aroma and fungus free growth 30 higher yields, and 8-10 days earlier harvest when the horn silica preparation was sprayed after harvest of the last crop and not in spring. He discussed the polar effects of this preparation as related to environmental factors of soil, light, intensity and moisture. by stimulating one phase in the plants growth one can help the polar opposite phase to reach its full potential (Von Mackensen 1994) Bloksma ,(1995) found that young apple trees in pots in a nursery showed more balanced growth and developed less side branches if the preparation 500 and 501 were applied

Crop yield and root growth were studied in a 6- year trail comparing conventional, organic and biodynamic methods of fertilization. Intense use of a set of preparations, including a nettle-containing compound preparation, was found to have a balancing effect on the yield of maize and winter wheat, this effect may have been caused by greater root growth and improved root health. Goldstein .Wand .Barber, 2005

In the cotton tried increasing the number of quartz application (BD501) from 3 to 5 times increased yield production by almost 10 % also changing the timing of the application in the wheat has shifted the yield increase from grain to straw. These results need further investigation. Bisterbosch(1994) found in her research on lettuce , which included extensive phenomenological observation and food tests , that application of preparation 500 and 501 more than once during the growth season negatively affected product quality . She concluded that a healthy ordering of live processes was disturbed

From the previous results the full package of the biodynamic applications, i.e. following the agenda timing and applying the preparations gave very significant increase in all measures parameters for the three crops, cotton, and sesame and wheat
Further research should be conducted to show how the preparations function, to better understand how they produce such great influence on crop productivity,

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