International Journal of Microbiology Research
ISSN: 0975-5276 & E-ISSN: 0975-9174, Volume 9, Issue 5, 2017, pp.-895-896.
Available online at http://www.bioinfopublication.org/jouarchive.php?opt=&jouid=BPJ0000234

Research Article

EFFECTS OF TIME OF APPLICATION AND CONCENTRATIONS OF NANO ZNS ON CHLOROPHYLL CONTENT (SPAD) OF SUNFLOWER (*Helianthus annuus* L.)

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Received: April 23, 2017; Revised: May 06, 2017; Accepted: May 07, 2017; Published: May 28, 2017

Abstract- A pot experiment was conducted during *rabi season* 2014-15 to study the effects of time of application and concentration of nano zinc sulphide (ZnS) on chlorophyll content of sunflower (*Helianthus annuus* L). Among the different treatments foliar sprayed nano-ZnS 400 ppm at 35 DAS sowing recorded higher chlorophyll content compare to other treatments which were on par with 500 ppm nano-ZnS sprayed at 35 DAS. However, lowest chlorophyll were recorded under water sprayed treatment.

Keywords- Sunflower, Spad, Nano ZnO

Citation: Meena Dharam Singh, et al., (2017) Effects of Time of Application and Concentrations of Nano Zns on Chlorophyll Content (SPAD) of Sunflower (*Helianthus annuus* L.). International Journal of Microbiology Research, ISSN: 0975-5276 & E-ISSN: 0975-9174, Volume 9, Issue 5, pp.-895-896.

Academic Editor / Reviewer: Ramzan Shazia

Introduction

Sunflower (*Helianthus annuus* L.) is one of the few crop species that originated in North America. Sunflower is important edible oilseed crop in India after groundnut, mustard and soybean which occupies 0.64 m ha cultivated in area of 0.64 m ha with 0.54 m t total production and 791 kg/ha average productivity. In India, major producer of sunflower are Karnataka, Maharashtra and Andhra Pradesh [1]. In Karnataka, it is grown in area of 0.44 m ha with production of 0.29 mt and productivity of 670 kg ha^{-1}[2]. The major sunflower growing districts in Karnataka are Raichur, Gulbarga, Bijapur, Koppal, Bellary, Chamarajnagar, Tumkur, Chitradurga and Gadag. The average productivity at all India level was 900 kg/ha depending on the climatic conditions and irrigation, which are critical factors for high yield.

Zinc deficiency appears to be the most widespread at world and national level which influence the crop growth, yield and quality parameters because it most important nutrient require for activation of six enzymes classes (oxidoreductase, transferases, hydrolases, lyases, isomerases and ligases and play important role in chlorophyll production, pollen function, fertilization and germination [3-6]. Among all metals, Zn is needed by the largest number of proteins. Zinc-binding proteins make up nearly 10 % of the proteomes in eukaryotic cells, and 36% of the eukaryotic Zn-proteins are involved in gene expression. Tolerance to environmental stress conditions has a high requirement for Zn to regulate and maintain the expression of genes needed to protect cells from the detrimental effects of stress. Hence to increase crop production meet the global food requirement need to concern about zinc efficient nutrient source which help in increase availability of zinc to the plant.

Nano-fertilizers are most important emerging tools in nutrient management in crop production because they increase availability of nutrient to the plant, require in less quantity, high penetrability, high surface area, water soluble and less residual hazard in the environment these properties increase metabolic activity inside the plant which leads to increase photosynthesis accumulation and prevent environment problems.

Material and Methods

A pot experiment was conducted during *rabi* 2014-15 to study the effect of time of application and concentration nano zinc sulphide (ZnS) on the growth and yield of sunflower (*Helianthus annuus* L) in IABT polyhouse, University of Agricultural Sciences, Dharwad.

Synthesis of nano zinc sulphide (ZnS)

Nano zinc sulphide was synthesized by following standard procedure of Ramanery *et al.,* 2013 [7]. Nano zinc sulphide fertilizer was synthesized in nano lab of IABT Department, University of Agricultural Sciences, Dharwad.

SPAD 502 Plus chlorophyll meter

It measure chlorophyll content in plant leaf which directly related with N content It is non-invasive measurement simply clamp the meter over the leafy tissue and receive an indexed chlorophyll content reading (-9.9 to 199.9) in less than two second.

Result and Discussion

Among the different concentration of nano-ZnS foliar sprayed at 35 DAS and 55 DAS 400 ppm nanoZnS foliar sprayed at 35 DAS recorded higher chlorophyll content at 60 DAS (36.81) which was on par with 500 ppm nanoZnS foliar sprayed at 35 DAS (35.81) but at harvest SPAD value was reduced due to decrease chlorophyll content in leaves due to senescence and yellowing of the leaves at harvest and at 30 DAS there is no significance difference in chlorophyll content.

Prasad *et al*. (2012) reported similar result that nano-scale ZnO at 1000 ppm recorded the highest chlorophyll content (1.97 mg/g/rt.wt). Higher chlorophyll accumulation may be due to complementary effect of other inherent nutrients like magnesium, iron and sulphur [8]. However lowest SPAD value recorded under

water sprayed at all stages it is mainly because of deficiency if nutrients in case of water sprayed treatment and recorded lowest chlorophyll content. Mei-yan Wu (2013) reported that SPAD value indicates the relative amount of chlorophyll and the photosynthetic rate of the leaves [9]. Morteza *et al.* (2013) reported that highest amount of chlorophyll SPAD was obtained by spraying of nano titanium dioxide at the concentration of 0.03% at the stage of the appearance of male and female flowers [10].Meena et al., (2017) also coated similar reason to increase chlorophyll content in the plant by using nano particles [11]. Meena D. S. and B. N. Aravinda K. (2017) also reported positive effect of nano zinc sulphide on growth parameters of sunflower.

Table-1 *Effects of time of application and concentrations on chlorophyll content (SPAD value) of sunflower*

Treatment	SPAD		
	30 DAS	60 DAS	Harvest
1: T_1 C_1	30.50	34.9	30.37
2: T_1C_2	30.38	34.24	31.33
3: T_1C_3	30.79	35.27	31.80
4: T_1C_4	30.96	36.81	32.13
5: T_1C_5	30.75	35.81	32.57
6: T_2C_1	29.18	33.41	30.00
7: T_2C_2	29.90	34.86	30.20
8: T_2C_3	29.90	34.94	31.17
9: T_2C_4	30.20	35.26	32.30
10: T_2C_5	30.10	35.67	32.83
11. WS @ two stages	29.41	30.91	29.93
12. RPP +WS @ two stages	29.86	33.71	31.10
S.Em±	0.6	0.74	0.66
CD at (p=0.05)	1.45	2.20	1.94

Note:T1 - Vegetative stage (35 DAS), T2 - 50 % flowering stage (55 DAS and C1 - nano- zinc sulphide @ 100 ppm, C2 - nano- zinc sulphide @ 200 ppm, C3 - nano-zinc sulphide @ 300 ppm, C4- nano zinc sulphide @ 400 ppm, C5 - nano zinc sulphide @ 500 ppm. The recommended package of practices (RPP) – FYM @ 8 t. ha-1 + 35: 50: 35 kg N: P2O5: K2O ha-1+10 kg ZnSO4 and from treatment 1 to 11 RPP followed except the application of $ZnSO_4$ biased on RPP nutrient requirement per pot calculated.

Conclusion

This is a new emerging field of nutrient management in agriculture with improve nutrient use efficiency, better uptake of applied nutrient which reduce environment hazards. In present experiment among the different concentration of nanoZnS foliar sprayed at 35 DAS and 55 DAS 400 ppm nanoZnS foliar sprayed at 35 DAS recorded higher chlorophyll content which leads to better growth and yield of plant.

Acknowledgement / Funding: Author are thankful to University of Agricultural Sciences, Dharwad, Karnataka-580005

Author Contributions: All author equally contributed

Abbreviations

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

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