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Effect of bio stimulants on some physiological parameters of *Psium satvium*

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ABSTRACT **: Bio stimulants are gaining a more attention as being ecofriendly to human and environment. This study was conducted to evaluate the impact of two bio stimulants (*Spirulina platensis and Trifolium alexandrinum*) on some physiological parameters of one leguminous plant (*Psium satvium L.*).To achieve this goal four treatments were done in this experiment: Control without any treatment, Soil treated with 10 g of powdered *Spirulina*, Soil treated with 10 g of powdered *Trifolium* and finally soil treated with two bio stimulants (10 g *Spirulina* +10 g *Trifolium*).The obtained results clarified that all tested growth parameters were increased .Total pigments were increased with special references to combination of two bio stimulants. Parellel, Total carbohydrates were generally enhanced in all treatments if compared with control Water soluble vitamins as vitamin B Complex ,biotin, choline, folate, vitamin A,E and K were enhanced as a result of application of bio stimulants. On the other hand, No changes were revealed in Vitamin A, B2, B3, B5, B6, Cartenoid (α,B.Carotene, Cryptoxanthin, Leutin and zeaxanthin).**

KEYWORDS: Bio stimulants , Carbohydrates, Psium satvium, Vitamins-Total pigments.

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I. INTRODUCTION

The overuse of synthetic agrochemicals have resulted in massive ecological degradation throughout the world leading to ocean dead zones , eutrophication , soil infertility and biodiversity loss (Kohler and Triebskorn, 2013,Chagnon et al .,2014,Hallmann et al .,2014). Chemical fertilizers are needed to get good crop yields but due to their abuse, they can be harmful for the environment and their cost can make them not economic agricultural products (Bobade et al.,1992). Chemical fertilizers are expensive; cause pollution to the environment .These problems may be avoided by the use of bio fertilizers (AL-Khiat, 2006). There are attempts have been undertaken to substitute chemical fertilizers with bio fertilizers such as cyanobacteria (blue green algae) (Asari et al.,2008). And Trifolium which rich in nutrients (Fulkerson et al.,2007). The role of bio fertilizers in sustainable agriculture recorded special significance , particularly in the present context of high cost of chemical fertilizers (Kannaiyan , 2002). Bio fertilizers are containing living microorganisms or natural compounds derived from organisms improve soil chemical and biological properties , stimulate plant growth and restore soil fertility(Raouf et al .,2012).

Bio fertilizers such as Cyanobacteria (blue green algae) that are capable of fixing atmospheric nitrogen (Asari et al.,(2008). It have many advantages than chemical bio fertilizers , they are non-polluting , inexpensive, utilize renewable resources , in addition to their ability of using free available solar energy to fix atmospheric nitrogen and carbon dioxide.besides they supplying N2 to crops and supply other nutrients such as vitamins and growth substances (Wagner , 1997).

The use of algae as a bio fertilizers provide a possible solution to the previous problems. The bio fertilizers not only enhance agricultural production but also diminish environmental pollution (Kawalekar, 2013).

Cyanobacteria can play a major role in the sustainable agriculture by increasing the soil fertility, crop growth and yield and improvement of the environmental quality (Singh et al., (2016) & Osman et al., (2016). It has been proven that cyanobacteria have the ability to fix atmospheric nitrogen into usable forms for plants and hence, affects rice fields(Pereira et al.,(2008),Sharma et al.,(2010).Also, several reports showed that the beneficial effects of higher plant bio stimulants on the growth and yield of many crops such as (Trifolium) (Elzaawely et al.,2017),garlic cloves(Elzaawely et al.,2008).It well known that legume application as bio stimulant not only increases total soil organic carbon and nitrogen content but also reduces negative

environment impacts (Blesh,2019).Soil incorporated with plant residues from green manure showed activation of the physic-chemical protection of organic carbon(Garcia-Franco et al.,2015)and this triggers plant health by improving the plant nutrition. Trifolium alexandrinum (Egyption clover) is a highly nutritious forage due to its high amounts of nutrients, particularly protein (15-25%DM), minerals (11-19%) and carotene (Fulkerson et al.,2007).Additionally, it is rich in trace elements such as Fe, Zn, Mn and Se.

Materials and Methods

1-Materials

Healthy and viable seeds free from visible infection, with uniform size of pea (Psium satvium L) were obtained from Horticultural Research Institute Center of Egypt.

2-Experimental program

Before cultivation, the field was plowed and laid out into four rows. Each row with 16 lines, each line has 3.5m×80 cm). Each line was treated with powders of Spirulina platensis (A) and Trifolium alexandrinum (F), in addition to control. Three weights from each treatment were applied (2.5, 5, 10 g) for Spirulina platensis (A) and Trifolium alexandrinum (F) separately and in combinations.in three replicates. Then the field was irrigated.

After the irrigation, the seeds were cultivated during winter season (October 2018/march 2019).The time of the experiment was lasted for 4 months, during this period, the phonological parameters were taken and examined weekly. At the end of incubation peroid, the seeds were collected, dried, and ground to fine powder, and then the biochemical analyses were done.

3-Growth characteristic and yield:

Growth parameters like shoot length (cm), leaf area (cm2), number of leaves were recorded in table (1-3).Samples were taken randomly after 45 days from sowing. At the harvest period, Pea samples were taken to determine the yield components like the number of pods/plant, pod length (cm) according to (Rao et al., 1976).

4-Determination of biochemical components:

The plant photosynthetic pigments (Chlorophyll a, Chlorophyll b and Cartenoid) were determined according to the method adapted by Metzner et al.,(1965). Total carbohydrate determined as method described by Said and Naguib(1946). Vitamins were determined according to the method of AOAC (2005).

Results

1-Vegetative growth characteristics:

Data in Tables (1, 2, 3,4,5,6 and 7) clarified that all the studied growth parameters were significantly increased by raising the concentration of the bio stimulants either Spirulina sp or Trifolium sp if compared with control. The same trend was occurred under application of the two fertilizers.

2-Total pigment contents:

Table(2-1) clarified that application of two bio fertilizers (Spirulina platensis (A3) & Trifolium alexandrinum (F3) to soil led to a marked increases in the total pigments in soil treated with F3 , followed by A3 if compared with control since it was 74.342 &34.676 mg/g in F3 ,A3 respectively .The previous increase in total pigment was due to the highly increase in carotenoid (56.047 & 26.035 mg/g) in F3 and A3 respectively .Moreover, The combination of two bio fertilizers resulted in a highly increase in total pigments 76.901 mg/g if compared with control (7.118 mg/g).

3- Total carbohydrate fractions

The analysis of carbohydrate fractions including DRV (Direct reducing value), polysaccharides and TRV (total reducing value) Table (2-2). The application of bio fertilizers led to general increase in total carbohydrate fractions in all treatments if compared with their corresponding control. The highest percentage of increase was recorded in F3 since it was 71.128 mg/g, followed by combination A3F3, since it was 29.312 mg/g followed by A3, since it was 24.534 mg/g. Such increase in total carbohydrate fractions may be attributed to the increase in total reducing sugar with a decrease in polysaccharides.

4- Vitamins Contents

Evaluation of water soluble vitamins such as vitamin B-complex , biotin , choline , folate , pantothenic acid ,Vitamin A,E and K ,Data in Table (2-3) showed that the treatment of Psium satvium by two selected bio fertilizers (Trifolium alexandrinum(10 g) & Spirulina platensis (10 g) resulted in an increase in the amount of vitamin B1 since it was 8.94 mg/g , 7.11 mg/g if compared with control (6.22 mg/g). also Biotin vitamin B7 was also increased since it was 17.46 mg/g , 12.45 mg/g in A3 & F3 respectively if compared with control(7.43). Moreover, vitamin B9 was also increased 4.81mg/g , 3.73 mg/g in A3 & F3 respectively . the same trend was also observed in vitamin B12 ,4.23 mg/g & 3.11mg/g in A3 & F3 respectively .Choline (14.41 mg/g & 12.31 mg/g) respectively , Folate (11.81 mg/g & 9.31mg/g) respectively , vitamin C (13.16 mg/g , 11.27mg/g), vitamin E (11.11mg/g , 8.32mg/g) finally vitamin k (10.52 mg/g , 8.74 mg/g) in A3 & F3

respectively . On the other hand no changes were observed in vitamin B2 , B3 , B5 , B6 ,Folate (DFE) , Folate (Food) and pantothenic acid , vitamin A , Carotenoid (α , B , Carotene , cryptoxanthin , lutein and zeaxanthin).

Discussion

Bio fertilization is an important tool to enhance the yield. It becomes an alternative biotechnology to chemical fertilizers. It has many merits; it is safe for human and environment. It gained significance in sustainable agriculture as it enhancing crop productivity to friendly environment and reducing polluting effects of synthetic fertilizers (Singh et al., 2011). Algae considered as photosynthetic organisms, including prokaryotic cyanobacteria and euokaryotic microalgae as well as a macro forms such as sea weeds (marine forms) (Lee, 2008). The algae either micro or macro- forms have a significant role in environmental carbon sequestration and are responsible for 50% of the total photosynthesis on the earth (Moroney and Ynalvez, 2009). The utilization of cyanobacteria and eukaryotic green microalgae in the Mineralization, mobilization of organic compounds with the production of bioactive compounds such as (polysaccharides, growth hormones, antimicrobial compounds, etc.) can improve the plant growth and thus makes them suitable as bio fertilizers options (Gayathri et al., 2015 and Prasanna et al., 2016a). They have a key role in maintaining the productivity of terrestrial and aquatic ecosystems through photosynthesis and N fixation, and improving the availability of nutrients through cycling and transformations (Moroney and Ynalvez, 2009). Application of nitrogen fixing cyanobacteria called algalization which not only enhanced the nitrogen status of the soil and plant but also minimizes the use of chemical nitrogen fertilizer (Etesami and Alikhani, 2016). Microalgae, especially cyanobacteria are also considered as potential bio control agents as they exhibit antagonistic effect against many plant pathogens such as bacteria, fungi and nematodes, mainly as a result of production of hydrolytic enzymes and biocidal compounds such as benzoic acid, etc. (Gupta et al., 2013). These antimicrobial compounds can suppress pathogenic microbes through the disruption of the cytoplasmic membrane, and inhibition of protein synthesis, etc. (Swain et al., 2017). The inoculation of these organisms influences various metabolic processes in plants as they elicit the activity of plant defense enzymes, thereby transporters, chelating agents etc. that lead to enhanced plant immunity to pathogens, and increase in plant growth and crop yields (Gupta et al., 2013).

The potential use of microalgae as bio fertilizer, for enhancing soil fertility, plant growth, fruit quality and nutritional characteristics and grain yield (Coppens et al., 2016). However, recent studies showed that the inoculation of cyanobacteria could also increase the availability of other micro-nutrients (Zinc, Copper Iron, etc.) and macronutrients (carbon, nitrogen, phosphorus, potassium) in soil and their translocation inside plants, up to grains (Coppens et al., 2016).

The present study highlights the prospects of cyanobacteria (Spirulina platensis) as options for bio fertilization, bioremediation, and as agents for improving soil structure and functioning, and enhancing plant growth and yields. Furthermore, It is known that Trifolium alexandrinum contains high amounts of trace elements like Cu , Fe , Se , Mn , Zn which are important in cell division and enlargement as well as photosynthesis resulting increased shoot growth (Lopez et al.,2008).The yield of pea were significantly affected by using bio stimulants , our results are consistent with (Badr et al.,2014; Zaghloul et al.,2015) who indicated that inoculated pea significantly surpassed on un-inoculated ones in a number of pods/plant , seed yield/plant , leaf area/plant, stem length/plant and pod length/plant. Additionally, Mishra et al.,(2010) said that application of bio stimulants led to a significant increase in the number of pods .This increase may be due to bio stimulants adding organic matter to the soil thus improving soil structure and thus enhancing plant growth and crop yield (Maqubela et al.,2009). By the way, Trifolium as gteen manure ,intercropped with oats in maize, increased maize yield by 10 % and returned 43 kg N/ha(Ghaffarzadeh,1997).The beneficial role of trifolium in plant growth resulting in higher yield due to enhance photosynthesis activity by nitrogen fixation and consistent with (Giambalvo et al., 2011).

Regarding the phenological characters of Psium satvium during different growth stages it was cleared that the addition of two biofertilizers (Spirulina platensis &Trifolium alexandrinum) to the test plant led to a marked increase in all tested parameters (Area of leaves, number of leaves, length of stem, number of pods and length of pods).the tested plant was highly responded to high dose of algae A3, plant F3 and their combinations (A3F3). These results might be due to the addition of biostimulants to plants modi¬fies the morphology of plant roots in a similar way to IAA, suggesting that they induce a “nutrient acquisition response” that favors the uptake of nutrients via an in¬crease in the absorptive surface area (Ertani et al., 2012).Also, they enhance nutrient use efficiency, stimulate plant development and growth (Kunicki et al., 2010; Calvo et al., 2014; Halpern et al., 2015; Le Mire et al., 2016), and eventually enhancing crop quality and yield (Ziosi et al., 2013; Van Oosten et al., 2017).The enhancement effect of algae extract on pea plant growth characteristics may be attributed to the auxin content of the algae extract which has an effective role in cell division and enlargement. This leads to increase the shoot growth, leaves number, and plant dry weight (Gollan and Wright 2006). Moreover, Spirulina

platensis is a rich source of potassium and contains considerable amounts of Ca, Cu, Fe, Mg, Mn, P and Zn(Marrez et al., 2014), which have a great role in cell division and enlargement and induce the photosynthesis and this in turn reflected on a great shoot growth (Lopez et al. 2008). The stimulative effect of algae extract might be attributed to that it contains trace elements and plant growth hormones (required for plant regulator) and high levels of organic matters and fatty acids available to plant which enhances yield parameters (Erulan et al., 2009). Microalgal extract used as a foliar spray application showed an increased plant growth. In particular, a high plant height and a great number of flowers and branches per plant were recorded when plants were sprayed with Arthrospira spp [Garcia et al., 2016] and Shalaby et al., 2014).

In case of pigment contents, addition of the two bio fertilizers (Spirulina platensis(A3) & Trifolium alexandrinum (F3) to soil led to a marked increases in the total pigments in soil treated with F3 , followed by A3 if compared with control since, it was 74.342 &34.676 mg/g in F3 , A3 respectively .The previous increase in total pigment was due to the highly increase in carotenoid (56.047 &26.035 mg/g) in F3 &A3 respectively .Moreover, the combination of two biofertilizers resulted in a highly increase in total pigments 76.901 mg/g ; if compared with control (7.118 mg/g).These results are in harmony with Paudel et al.,2012& Czeczko & Mikos-Bielak ,2004). stated that the most important of biofertilizers or biostimulants as Spirulina platensis and Trifolium alexandrinum is increasing content of chlorophyll in leaves , intensifying photosynthesis , Moreover, a significant increase in the carotenoid content under the influence of biostimulant application was also obtained by (Grabowska et al .,2012). Latique et al., 2013 reported that algae extract increased significantly total chlorophyll content in pea leaf tissues, Haroun and Hussein et al., (2003) said that using of algal bio fertilizers resulted in marked increase in Chl.a ,Chl.b , total chlorophylls and total pigments content of leaves. Higher sugar levels in plants treated with bio stimulants have been found in several species, associated with higher chlorophyll accumulation, net photosynthesis (Abbas and Akladious, 2013; Abdalla, 2013). Bio stimulants improve the primary metabolism of plants, increasing the levels pigments as reported by Yakhin et al. (2017).

With respect to the effect of selected bio fertilizers on carbohydrate contents of Psium sativum seeds, it could be stated that soil amended with two bio fertilizers Trifolium alexandrinum and Spirulina platensis either separately or in combination led to general increase in total carbohydrate fractions if compared with control plant. The highest increase was recorded in F3 followed by A3&F3 and finallyA3.This may be attributed to the increase in total reducing sugar and the decrease in in polysaccharides. These results are in harmony with Grabowska et al.,(2012)& Parallel,A.EBIC.,(2012) said that the application of bio stimulants resulted in the highly significant increase of total and reducing sugars .Moreover, (Adam.1999).Mohamed ELanwar et al.,(2010) said that the inoculation of soil with cyanobacterial species increased carbohydrates of produced pea seeds. Bio stimulants can be associated with an increase in carbohydrate concentration in leaves (Abdalla, (2013). Ghallab and Salem (2001) stated that due to using algal bio fertilizers led to increase in growth characters, nutrients, sugar of tested plant. Bio stimulants improve the primary metabolism of plants, increasing the levels of carbohydrates as reported by Yakhin et al. (2017). Also , The application of bio stimulants were led to an increase in the content of reducing sugars of the plant (Gurav et al,, 2013).Moreover, Dawa etal.,(2014) detected that application of bioferilizers had a significant increase on total carbohydrates, reducing sugar ,non – reducing sugar and total sugar .

Regarding the impact of two selected biofertilizers on vitamins content of Psium satvium Data in table (2-3) showed that the treatment of Psium satvium by high doses two selected bio fertilizers 10 g in case of Trifolium alexandrinum & 10 g in Spirulina platensis resulted in an increase in the amount of vitamin B1 also Biotin, vitamin B7 was also increased . Moreover, vitamin B9 was also increased. The same trend was also observed in vitamin B12 , .Choline, Folate, vitamin C vitamin E finally vitamin k in A3 & F3 respectively . On the other hand, No changes were observed in vitamin B2 , B3 , B5 , B6 ,Folate (DFE) , Folate (Food) and pantothenic acid , vitamin A , Carotenoid (α , B , Carotene , cryptoxanthin , lutein and zeaxanthin).These results agreed with(Nada et al .,2011) detected that a positive influence of bio stimulant on yield parameters was observed as well as on the vitamin C. Similar results have also been reported by Sendur et al. (1998) and Meena et al. (2013) Who indicates that the application of bio fertilizers showed maximum vitamin-C of plants.

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Tables:

Table (1): Phenological characters of *Psium* sativum treated with two selected biofertilizers (*Spirulina platensis & Trifolium alexandrinum*) during vegetative stage.

Treatments	Leaf area	No .of leaves	Length of stem
	No.= 3	No.= 3	No.= 3
Control	5.85±0.85l	4.5 ±0.5i	16.5±1.5i

A1	13.6 ±0.6k	7.5 ±0.5h	29.95 ±0.05h
A2	15.25 ±0.25j	8.5±0.5g	30.5±0.5h
A3	16.4±0.4i	9.5 ±0.5f	31.75 ±0.25g
F1	16.65 ±0.15hi	9.5 ±0.5f	32.5 ±0.5g
F2	17.15 ±0.15gh	10 ± 0.00f	33.75±0.25f
F3	17.55±0.05g	10.5±0.5e	35.5 ±0.5e
A1F1	18.25 ±0.25f	9.5 ±0.5f	35.1 ± 0.4e
A1F2	18.6 ±0.1ef	10.5±0.5de	35.25 ±0.25e
A1F3	19.15±0.15de	11.5±0.5c	36.75±0.25d
A2F1	19.7 ±0.21d	11± 0.00cd	36.5 ± 0.00d
A2F2	20.85 ±0.15c	11.5 ±0.5c	36.75 ±0.25d
A2F3	21.75 ±0.25b	12.5 ±0.5b	37.75 ±0.25c
A3F1	22.25 ±0.25b	11.5 ±0.5c	37.75 ±0.5c
A3F2	23.5 ±0.5a	12.5 ±0.5b	39.5 ±0.5b
A3F3	23.5 ±0.5a	13.5 ±0.5a	40.5 ±0.5a
f	426.235**	65.368**	348.102**
Test of Homogeneity of Variances	1.382 ns	0.512 ns	1.604

One- way ANOVA
L.S.D (Less Significant deference)
(a- a- Non significant difference , a- b significant difference)
Means with different letters within column are significant difference , P ≤ 0.05-0.01
Means with the same letters within column Non significant difference , P ≤ 0.05-0.01
***Significant at 0.05 ** Significant at 0.01.**

A1 :*Spirulina platensis* (2.5 g). A2:*Spirulina platensis*(5 g)
A3: *Spirulina platensis*(10 g). F1:*Trifolium alexandrinum*(2.5 g).
F2:*Trifolium alexandrinum*(5 g). F3:*Trifolium alexandrinum*(10 g).
A1F1: *Spirulina platensis*(2.5 g)and*Trifolium alexandrinum* (2.5 g).
A1F2: *Spirulina platensis*(2.5 g) and (5 g*) Trifolium alexandrinum.*
A1F3: *Spirulina platensis*(2.5 g) and (10 g*) Trifolium alexandrinum*
A2F1: *Spirulina platensis*(5 g) and (2.5 g*) Trifolium alexandrinum*
A2F2: *Spirulina platensis*(5 g) and (5 g*) Trifolium alexandrinum*
A2F3: *Spirulina platensis*(5 g) and (10 g*) Trifolium alexandrinum*
A3F1: *Spirulina platensis*(10 g) and (2.5 g*) Trifolium alexandrinum*
A3F2: *Spirulina platensis*(10 g) and (5 g*) Trifolium alexandrinum*
A3F3: *Spirulina platensis*(10 g) and (10 g*) Trifolium alexandrinum*

Comparison between different dyeing techniques of Polyester Fabrics Dyed with Disperse Dyes derived from Enaminones

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***ABSTRACT* : Some disperse dyes were prepared and applied in dyeing the polyester fabrics in an attempt to compare dyeing at low Temperatures and high temperatures by studying the dye uptake. Also, the optimal dispersing agent ratio for both methods was studied, which ranged from 0.5 to 2%. One method of dye bath reuse is to reconstitute the dye bath by adding the required amount of dyes and chemicals to prevent and reduce the contamination. The dye bath reuse has long been recognized as a**

strategy to prevent pollution and reduction of cost. During low temperature dyeing of PET fibers, carriers are used for improvement adsorption and acceleration of the dispersal of dyes dispersed in the fibers. Finally, the fastness properties were evaluated for two dyeing methods represented by Light fastness, washing fastness, rubbing fastness and perspiration fastness, where very good results were obtained, except for Light fastness, the results were satisfactory.

KEYWORDS: Low temperature dyeing, disperse dyes, high temperature dyeing, dye bath reuse.

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II. INTRODUCTION

Since the discovery of synthetic fabrics, the use of disperse dyes has steadily increased in textiles using different exhausting techniques [1-8].

One way of reusing the dye solution is to replenish the dye solution by adding the required amount of dye and chemicals to prevent and reduce contamination.

The reuse of dye solution has long been recognized as a strategy to prevent contamination and reduce costs [9-12]. It is known that when dyeing PET fibers at low temperatures, a carrier is used to improve the adsorption capacity and speed up the dispersion of dispersed dyes in the fiber. However, most of the carriers are toxic to humans and aquatic organisms, and during dyeing and discharging, a large amount of the carrier is discharged.

Discharge into wastewater has negative impact, harmful to the environment? On the other hand, when high temperatures are used to dye PET fibers.

The auxiliaries are not used to improve the adsorption capacity and accelerate the dispersion of disperse dyes in the fiber, at 130°C and the subsequent high pressure plays a role in achieving greater color depth if the two methods are compared.

In addition, the dye bath is virtually free of dye residue, thereby reducing residual substances in the wastewater, which has a positive impact on the environment [13-21]. In this study, polyester fibers were dyed with separate dyes in two different ways, namely low-temperature and high-temperature dyeing, and compare them to find the best one.

II. MATERIALS AND METHODS

Apparatus

The disperse dyes were prepared according to the procedures that we published in our previous research and checked by mass spectroscopy, essential examination, FT-IR, and 1H-NMR spectroscopy [1].

Study the optimum concentration of dispersing agent

Dye dispersions were prepared from disperse dyes 1-6 by dissolving the appropriate amount of dye (3% tint) in 2 ml of DMF and then adding it drop wise.

Add to the dye bath while stirring (liquid ratio 1:30) using different concentrations (0.5, 1, 1.5, 2%) of Levegal MDL as an anionic dispersant Tanatex Chemicals). The pH of the dye bath had been adjusted to 5.5 with 90% concentration acetic acid and the moistened polyester fabric was added. Dyeing was carried out by increasing the dye bath temperature at a rate of 3° C/min to 130° C. and maintaining this temperature for 60 minutes.

After cooling to 50 °C, the dyed fibers were rinsed in cold water and subjected to a reducing wash (1 g/L sodium hydroxide, 1 g/L Sodium hydrosulfite, 10 min, 80°C). The samples were rinsed with hot and cold water and finally air dried.

Dyeing procedure

A- First dyeing

Dye dispersions, disperse dyes 1-6, were prepared by dissolving the appropriate amount of dye (3% tint) in 2 ml of DMF and then adding it drop wise to the dye bath with stirring (liquid Ratio 1:30Contains levegal MDL (1.5%) as an anionic dispersant (Tanatex Chemicals) and Use TANAVOL EP 2007 (1%) as an eco-friendly anionic carrier (Tanatex Chemical) for 100°C dyeing, and dispersant only for 130°C dyeing. The pH of the dye bath was adjusted to 5.5 and moistened polyester fabric was added. Dyeing was carried out by increasing the dye bath temperature at a rate of 3°C/min to 100 or 130°C and maintaining this temperature for 60 minutes. After cooling to 50° C., the dyed fibers were rinsed with cold water and reduced washed (1 g/L sodium

hydroxide, 1 g/L sodium hydrosulfite, 10 min, and 80°C.). The samples were rinsed with hot and cold water and finally air dried.

B -Dye bath reuse

After dyeing, the dye bath was analyzed and reconstituted with the necessary amount of fresh water so as to maintain a constant bath ratio of the original volume. The residual pH of the dye bath was measured and maintained at pH 5.5. Reuse of the dye bath in dyeing followed the same procedure as in the previous two techniques. Finally, sodium hydroxide (3 g/l) and sodium were used to quench the reduction.

Hydrosulfite (2 g/L) is washed with 2% non-ionic detergent (pH 8) at 50°C for 15 minutes to improve wash fastness properties.

Color Measurements

The colorimetric parameters of the dyed polyester fabrics were measured with a reflectance spectrophotometer. The color development of the stained samples was determined using a light reflection technique performed on Ultra scan PRO D65 UV/VIS spectrophotometer. Color intensity, expressed as K/S values, was determined using the Kubelka-Mink equation [9].

$K/S = (1- R)^2 / 2R$

Where R is the reflectance of the colored sample and K and S are the absorption and scattering coefficients, respectively.

Color fastness to washing

Wash fastness was determined according to ISO 105-C02.method from 1989 [10]. A composite sample he sewed between two pieces Soak bleached cotton and wool fabrics in an aqueous solution containing 5 g/L non-ionic detergent at a ratio of 1:50. The bath was thermo stated at 60°C for 30 minutes. After the desired time, the samples were removed, rinsed twice with hand pressure, and then dried.

Finally wash fastness was evaluated using a gray scale of color change.

Color fastness to rubbing

Rubbing fastness was determined according to ISO 105-X12.1987test procedure. Tests are used to determine possible color grades Transfer by rubbing from one colored fabric surface to another. Current tests can be performed on both dry and wet fabrics.

Dry crocking test

The test specimen was placed flat on the base of the crock meter. A white testing cloth was mounted. The covered finger was lowered onto the test specimen and caused to slide back and forth 20 times. The white test sample was then removed for evaluation using the grey scale for staining.

Wet crocking test

The white test sample was thoroughly (65%) wetted with water. The procedure was run as before. The white test samples were air dried before evaluation.

Color fastness to perspiration

Two artificial sweat solutions (acidic and alkaline) were prepared according to ISO 105-E04 as follows.1989 test method.

Acidic solution It was prepared by dissolving L-histidine monohydrochloride monohydrate (0.5 g), sodium chloride (5 g) and sodium di hydrogen orthophosphate di hydrate (2.2 g) in 1 liter of distilled water. The pH was the finally adjusted to 5.5 with 0.1N NaOH.

To prepare an alkaline solution, L-histidine monohydrochloride monohydrate (0.5 g), sodium chloride (5 g) and disodium hydrogen orthophosphate di hydrate (2.5 g) were all added to 1 liter of distilled water.

Dissolved in The pH was adjusted to 8 using 0.1N NaOH. The authenticity test was performed as follows, A (5 cm x 4 cm) dyed sample was sewn between two pieces of undyed sample to form a composite sample.

Soak the composite sample in both solutions for 15-30 minutes, agitate well, and wring out to ensure complete wetting. The specimen was placed between two glass or plastic plates with a force of approximately 4-5 kg. The panel containing the composite sample was then held vertically in an oven at 37 ± 2°C for 4 hours. The effect on color of the tested samples was expressed and defined as a reference to the color change gray scale.

Color fastness to light

Light fastness testing was performed according to ISO 105-B02.1988 Test method using a carbon arc lamp and 35 hours of continuous light. The effect on the color of the tested samples was recorded using the blue shift scale.

III. RESULTS AND DISCUSSION

New disperse dyes 1-6 synthesized previously by us[10](Figure 1) were utilized in dyeing polyester fabrics at low temperature of 100 °C and high temperature of 130 °C to try to compare these two methods and study their stability properties.

Effect of dispersing agent on color strength K/S

The polyester fabrics were dyed with the disperse dyes 1-6, using the 1% carrier and at a temperature of 100 °C, we studied the use of the dispersing agent at different concentrations from 0.5-2% to study the optimum concentration giving the best value of K/S. The results set out in Table (3) indicate that the K/S values of the polyester fabrics dyed with the disperse dyes of the dyes 1, 3, 5 and 6 increase with the increase of the dispersing agent concentration and reach their highest values at a concentration of 1.5 %.The K/S values for the polyester fabric dyed with the disperse dyes of the 2 and 4 dyes also increase with increasing dispersing agent concentration and reach their highest values at a concentration of 2%. For the high temperature dyeing, the results set out in (Table 1) indicate that the K/S values of the polyester fabrics dyed with the disperse dyes of the dyes 1, 4 and 5increase with the increase of the dispersing agent concentration and reach their highest values at a concentration of 1.5 %. The K/S values for the polyester fabric dyed with the disperse dyes of the 2and 3 dyes also increase with increasing dispersing agent concentration and reach their highest values at a concentration of 1%, while, the highest K/S value for dye No. 6 at a concentration of 0.5%. It is clear from the results described in table 1 that when dyeing polyester fabrics with dispersed dyes at a temperature of 100 °C or 130 °C the most appropriate optimum conditions for the use of dispersing agent are 1.5%.

Relation between dyeing temperatures and K/S

In our attempt to find the relationship between the color strength K/S and the temperature used in the dyeing process, table (1),(2) and figure 2 revealed that the color strength K/S for high temperature dyeing at130 degrees was higher than the color strength K/S for low temperature dyeing at 100 degrees, with rates ranging from 6 to 363%, for all dyes used except for dye No. 3, we got the opposite, but the difference between the two readings does not exceed 5%. From the above, we can say that high temperature dyeing is better than low temperature dyeing

Dye bath reuse of low and high dyeing temperatures.

We used the prepared disperse dyes in dyeing polyester fabrics at a temperature of 100 or 130 0C, we noticed that the dye residues contain a quantity of dye, so we used liquid dye wastes in dyeing undyed polyester fabrics for the purpose of treating these wastes and at the same time Obtaining dyed fabrics at almost no cost, which positively affects the environment.

From the data obtained in table (4) that represented in figure (3), we observed that K/S value of the dye bath reuse process in the low temperature dyeing vary from 10-90% of its original value in the first dyeing process. Also, we observed that K/S value of the dye bath reuse process in the high temperature dyeing equal about 5-10% of its original value in the first dyeing process and this prove that high temperature dyeing is better than low temperature dyeing.

Fastness properties

The data listed in tables 5 and 6 showed that the fastness against washing, rubbing and perspiration gave very good results. The fastness properties against light gave acceptable results.

Generally, the fastness properties of high temperature dyeing method are better than low temperature dyeing method.

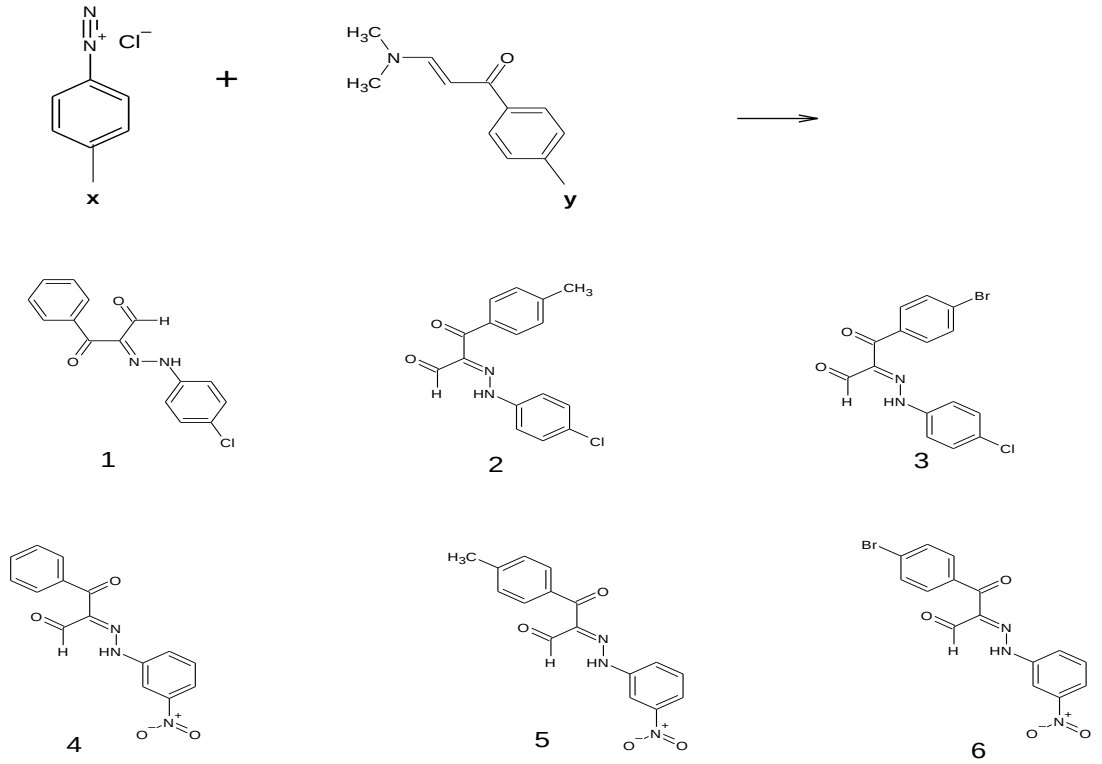

Figure (1) Chemical structures of the disperse dyes 1-6

Dye No	L*	a*	b*	C*	h*	K/S
1	38.49	-1.03	83.13	83.14	90.71	16.30
2	86.45	-8.60	67.57	68.11	97.26	11.68
3	87.12	-3.89	78.98	79.08	92.82	14.39
4	81.17	-0.23	51.38	51.38	90.26	13.75
5	83.62	-1.38	50.11	50.12	91.57	11.37
6	85.30	-2.29	37.85	37.85	93.74	3.01

Table (1) K/S value of low temperature dyeing process

Dye No	L*	a*	b*	C*	h*	K/S
19(a)	83.26	-0.12	83.09	83.09	90.08	17.14
19(b)	58.47	-7.64	75.87	76.26	95.75	15.54
19(c)	86.63	-9.02	75.02	75.56	96.86	13.76
19(d)	78.44	5.33	59.76	60.00	84.91	19.93
19(e)	81.06	2.85	57.38	57.45	87.15	16.47
19(f)	79.00	-3.11	47.57	47.57	93.84	13.95

Table (2) K/S value of high temperature dyeing process

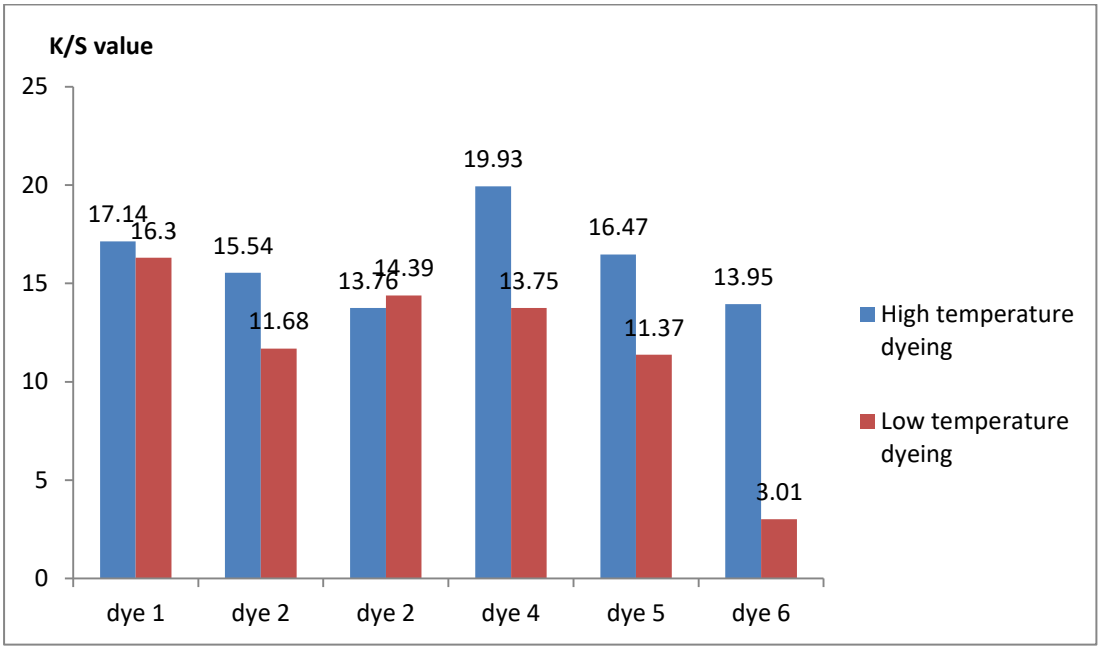

Figure 2.Relation between K/S and dyeing temperatures at the optimum conditions and 3 % shade

Dye NO	Dispersing agent %	K/S Low temperature dyeing	High temperature dyeing
	0.5%	9.46	11.80
1	1%	9.78	9.94
	1.5%	10.85	13.18
	2%	10.36	10.88
	0.5%	9.41	12.34
2	1%	9.89	16.99
	1.5%	8.48	11.63
	2%	10.23	15.85
	0.5%	9.29	9.43
3	1%	9.31	10.96
	1.5%	10.67	10.31
	2%	10.24	10.60
	0.5%	9.37	7.48
4	1%	7.88	9.53
	1.5%	7.15	10.27
	2%	10.36	9.47
	0.5%	8.64	11.13
5	1%	9.61	9.03
	1.5%	13.01	12.41
	2%	9.89	8.57
	0.5%	4.44	10.60
6	1%	6.62	4.67
	1.5%	7.54	9.22
	2%	7.29	7.48

Table 3: Dispersing agent effects on the dyeing process at low and high temperature dyeing

Dye No	K/S of Low temperature dyeing at 100 °C First	Dye	K/S of High temperature dyeing at 130 oC First	Dye reused

	dyeing	reused	dyeing	
1	16.30	3.33	17.14	1.26
2	11.68	11.15	15.54	1.64
3	14.39	8.12	13.76	0.88
4	13.75	3.28	19.93	2.98
5	11.37	1.13	16.47	1.77
6	3.01	1.12	13.95	4.35

Table (4) K/S value of dyeing and dye reuse for low and high temperature dyeing

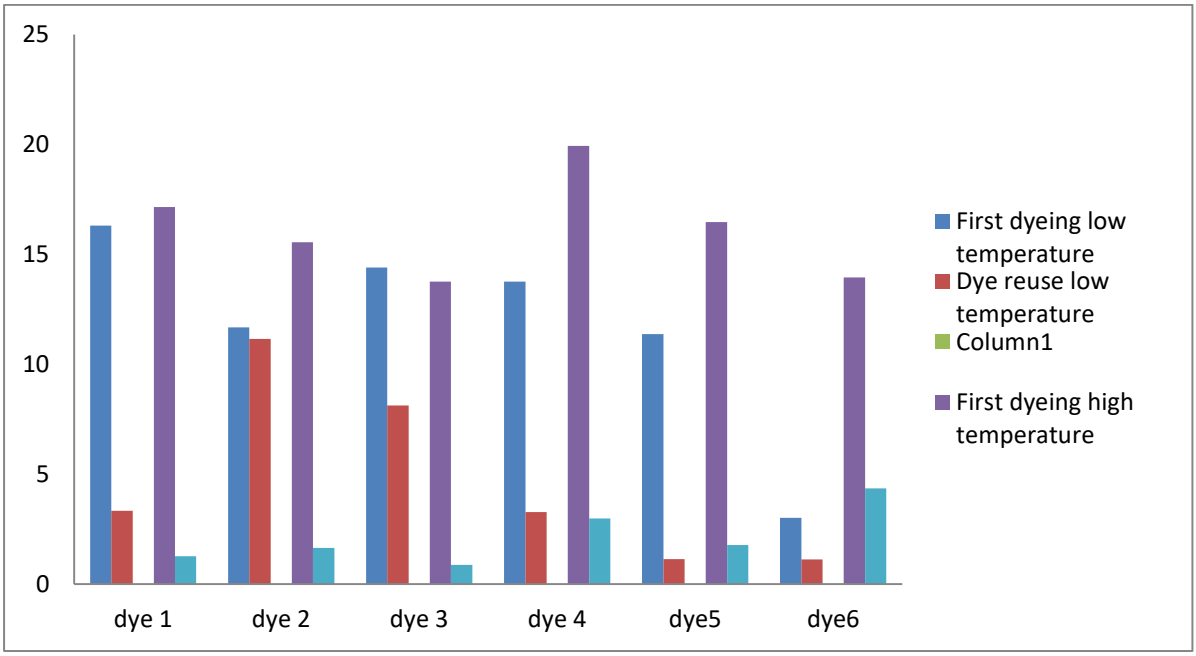

Figure 3.Relation between K/S of dyeing methods and dye

V –CONCLUION

The disperse dyes were synthesized by us were utilized in dyeing polyester fabrics at low and high temperature, The most suitable conditions for the use of a dispersion agent are 1.5% when dyeing polyester fabrics with disperse dyes at a temperature of 100 ° C or 130 ° C. The color strength K/S and fastness properties of high temperature dyeing method are better than low temperature dyeing method where, his fastness against washing, rubbing and perspiration gave very good results while the fastness properties against light gave acceptable results.

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