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Studies on reproductive biology of strawberry (*Fragaria X ananassa* Duch.) as influenced by humic acid and water soluble fertilizers under hilly conditions of western ghat. (Duration of flowering, bud development, flower characters, anthesis and dehiscence, yield)

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Abstract
To know the performance of strawberry as influenced by humic acid and water soluble fertilizers on reproductive parameters and yield parameters under naturally ventilated polyhouse. The study was made during 2017-18 with completely randomized design by taking fourteen treatments replicated thrice. The results revealed that application of 100% RDF through soil along with foliar application of humic acid (2%) + 19:19:19 (1%) + potassium nitrate (1%) recorded significantly lesser Days taken for stepping up stages of bud growth (13), first flower initiation (53.83), fruit set (58.29 days), Days taken from flower initiation to berry maturity (23.30), and higher bud size at different stages, Duration of flowering (72.90 days), maximum rate of anthesis and dehiscence took more at 10 am to12 pm, number of flowers per plant (24.74), fruits per plant (21.99) helped to get higher fruit yield of 4.55 Kg / plot followed by application of 75% RDF through soil along with foliar application of humic acid (2%) + 19:19:19 (1%) + potassium nitrate (1%) that yielded 386.67 Kg / pl.

Keywords: Strawberry, humic acid, water soluble fertilizers, Anthesis and dehiscence, flowering, yield

Introduction
Strawberry (*Fragaria x ananassa Duch.*) belongs to the family Rosaceae with basic chromosome number of X = 7. The cultivated strawberry is an octoploid, obtained by the hybridization of two North American species *Fragaria chiloensis* and *Fragaria virginiana* developed in France during seventeenth century. Strawberry plant is a low creeping short day perennial herb and a crown arise from basal leaves. Leaves are compound, with three leaflets saw tooth edged and hairy. The flowers are white in colour borne in small clusters, offers quicker returns on capital investment. Fruit is most delicious, nutritious, refreshing, soft fruit crop possess anticancer compound called ellagic acid.

Strawberry has certain seasonal fruiting varieties which produce a single crop in summer with limited vegetative growth occurs during short period. As a result the fruit produced is not of good quality and have a minimum marketable yield (Asrey *et al*., 2004; Singh *et al*., 2007) [2, 17] A profitable crop production is based entirely on balanced plant nutrition under suitable agro-ecological conditions. Abundant plant growth and development needs an adequate supply of various nutrients which are absorbed through plant roots and leaves. Hence, Foliar application may be accomplished in terms of contemporary technique for correction of nutrient level in plants during critical stages of the plant and environmental factors affecting flower development may limit the yields of fruiting crops worldwide Now-a-days interest in multi-nutrient foliar feeding in the form of water-soluble fertilizers enhancing at large and effective in correcting deficiencies on time scale. As compared with applications of plant nutrients to soil, foliar fertilization is credited with rapid correction of nutrient deficiencies, greater control over vegetative and fruiting responses because plants never lost their ability to absorb nutrients through their aerial parts. The Recently humic acid and water-soluble fertilizers has been practiced commercially to increase production and quality of strawberry crop.

Material and methods

Investigation was carried out on cv. winter dawn in the experimental blocks of the Fruit Science Department, COH Mudigere situated in the Western Ghats and represents the typically hilly zone (Zone-9 and Region-V) of Karnataka, India. It is located at13^0 25' North latitude and 75^0 25' East longitude with an altitude of 982 m above mean sea level. The experiment was conducted in Completely Randomized Design with fourteen treatments laid in three replications. Tissue cultured plants of winter dawn variety of strawberry was planted at a spacing of 30 cm × 30 cm on raised beds with 12 plants per plot *viz*., 6 plants of 2 rows. Recommended dose of NPK (150:100:120 kg / ha) was applied through soil and plants were fertilized with different combination and concentration *viz*., T_1-100% RDF + Humic acid (2%) foliar application, T_2-100% RDF + 19:19:19 (1%) foliar application, T_3-100% RDF + potassium nitrate (1%) foliar application, T_4-100% RDF + Humic acid (2%) + 19:19:19 (1%) foliar application, T_5-100% RDF + Humic acid (2%) + potassium nitrate (1%) foliar application, T_6-100% RDF + Humic acid (2%) +19:19:19 (1%) + potassium nitrate (1%) foliar application, T_7-75% RDF + Humic acid (2%) foliar application, T_8-75% RDF + 19:19:19 (1%) foliar application, T_9-75% RDF + potassium nitrate (1%) foliar application, T_{10}-75% RDF + Humic acid (2%) + 19:19:19 (1%) foliar application, T_{11}-75% RDF + Humic acid (2%) + potassium nitrate (1%) foliar application, T_{12}-75% RDF + Humic acid (2%) + 19:19:19 (1%) + potassium nitrate (1%) through foliar application, T_{13}-100% RDF through soil, T_{14}-75% RDF through soil at an interval of 45, 60 & 75 days after planting. Humic acid and 19:19:19, Potassium nitrate were choosen for the test, desired concentration of selected fertilizers were prepared fresh and used for the study. Subsequently at definite intervals the data on observations on reproductive parameters include Days taken for stepping stages of bud growth, first flower initiation, fruit set, Days taken from flower initiation to berry maturity and higher bud size at different stages, maximum rate of anthesis and dehiscence, number of flowers per plant, fruits per plant, Number of pickings and fruit yield.

Result and discussion

Flower bud initiation was recorded as emergence of flower bud from days after planting. Duration from bud initiation to berry maturation was perceived as days required after initiation of bud to fruit maturity. Total duration from first flower to last flower emergence in that particular season was recorded as duration of flowering. As per the observation flowering in strawberry under hilly conditions of mudigere commences between the last week of January up to last week of march with peak period of 25-38 days after opening of first flower (Table -3) and total period was recorded to be about 80 - 85 days. In January first flower was emerged and it took about three to four weeks for berry maturation. In all these parameters Treatment T_6-100% RDF + Humic acid (2%) +19:19:19 (1%) + potassium nitrate (1%) foliar application resulted that it took minimum days for bud initiation (53.83), bud initiation to berry maturity (23.30) and longer duration of flowering (72.90) followed by T_{12}-75% RDF + Humic acid (2%) + 19:19:19 (1%) + potassium nitrate (1%) through foliar application.

The maximum number of days taken for bud initiation (65.20) and berry maturity (30.91 days) and minimum days of duration of flowering (58.15) was recorded in T_{14} (75% RDF through soil application). Reduced number of days for berry maturity might be due to effective utilization and accurate application of fertilizers in soluble form to the functional aerial parts through foliar application resulting in vigorous growth of plants and consequently, they took lesser days for early achievement of required differentiation of flower bud. (Madhumathi *et al*. 2004) [12]. The results are in conformity with the findings of Eshaghi *et al*. (2012) [20] in strawberry and Kaur *et al*. (2012) [9] in peach. Longer duration of flowering might be due to frequent foliar fertilization caused high C/N ratio, humic acid and NPK fertilizers store sufficient amounts of photosynthates for producing more number of flowers during vegetative stage which would have promoted extension of flowering period. Results of the present investigation are in confirmation with those of earlier workers Kazemi (2014) [10], Kazemi (2014) [10] in strawberry and Rajput and Singh (1988) [14] in mango.

Flower bud development

In this parameter study we recorded minimum days for flower bud development in the plants from its first appearance to the full bloom stage with highest length x breadth size was divided into VIII stages (Table 1). The morphological characteristics of buds at different stages growth are explained.

The analysis of data showed significant differences among different treatments for bud development (Table-1). The treatment T_6-100% RDF + Humic acid (2%) +19:19:19 (1%) + potassium nitrate (1%) foliar application showed highest flower bud size with both length and breadth. It has been reported in apple that the flower bud development period as determined on the basis of length to diameter ratio appeared to be a good indicator for examining flower bud development (Sharma).

Stage I: Flower buds at this stage were just visible to the naked eye, when we observed minutely, buds are very smooth and delicate, greenish, conical, hairy and highly pubescent. The average size of Length and Breadth as 0.60 x 0.40 respectively.

Stage II: in this stage flower buds are slightly turned conical to oval in shape and slightly pubescent. The buds were little bit bigger than those in first stage. The size of the buds increased slowly and was measured by scale and recorded as (1.20 x 0.60 cm)

Stage III: During this stage buds are light greenish, plump and pubescent. Size of the buds was (1.63 x 0.95 cm)

Stage IV: In this stage we observed particular distinction of the sepals which give corolla. The size of bud was about (1.75 x 1.0 cm)

Stage V and stage VI: During this stage the corolla had started opening slightly. The pistils and stamens are also visible from top of the bud. The lobes of the calyx and epicalyx have aparted each other. Buds become more frequent and noticeable for pollination. The size of bud was measured to be (1.91 x1.50 cm) respectively.

Stage VII and stage VIII: In VII stage 50% of flowering takes place. To reach the last stage of the flower buds take

only one and half an hour from preceding one. This is the full bloom stage picturing a sign of anthesis and dehiscence by exposing the various whorls and reproductive parts (Table -1). The bud size measured 2.5 x 2.0 cm respectively.

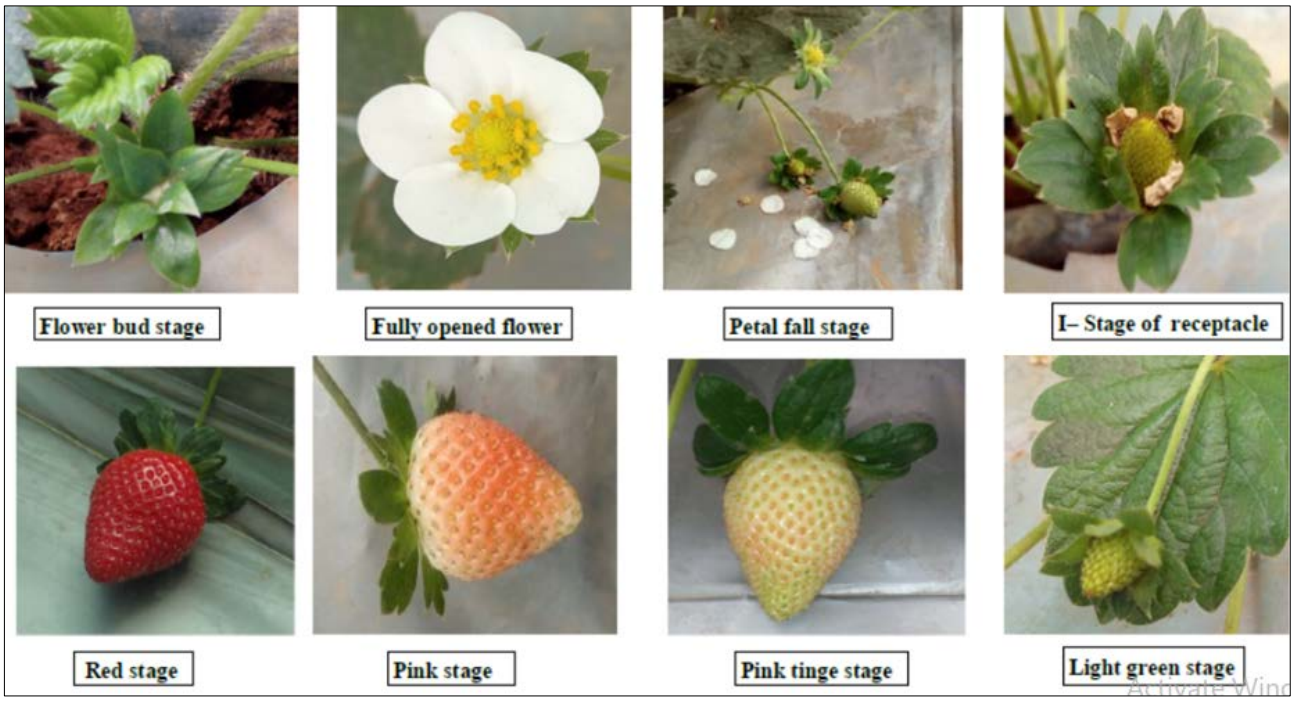

Fig 1: Different stages of flower bud and fruit development

Table 1: Influence of humic acid and water soluble fertilizers on bud size of strawberry (cv. winter dawn)

Treatments	I-II (cm)		II-III (cm)		III-1V(cm)		IV-V (cm)		V-VI (cm)		VI-VII (cm)		VII-VIII (cm)	
	Length	Width	Length	Width	Length	Width	Length	Width	Length	Width	Length	Width	Length	Width
T_1	0.15	0.11	0.17	0.13	0.30	0.26	0.68	0.54	0.88	0.63	0.90	0.78	0.98	0.83
T_2	0.28	0.15	0.30	0.26	0.63	0.46	1.0	0.72	1.18	0.98	1.38	1.08	1.50	1.20
T_3	0.18	0.13	0.20	0.19	0.50	0.38	0.90	0.68	1.0	0.83	1.12	0.93	1.18	0.95
T_4	0.42	0.36	0.6	0.52	1.2	0.72	1.34	0.93	1.72	1.33	1.76	1.40	1.98	1.53
T_5	0.35	0.28	0.41	0.40	0.95	0.58	1.28	0.97	1.58	1.12	1.62	1.18	1.78	1.30
T_6	0.60	0.40	1.20	0.60	1.63	0.95	1.75	1.30	1.91	1.50	2.0	1.70	2.5	2.0
T_7	0.13	0.10	0.15	0.11	0.22	0.24	0.63	0.52	0.73	0.60	0.89	0.68	0.92	0.70
T_8	0.24	0.14	0.26	0.22	0.58	0.42	0.98	0.71	1.10	0.89	1.18	0.98	1.20	1.0
T_9	0.16	0.12	0.18	0.14	0.32	0.28	0.73	0.60	0.98	0.80	1.0	0.84	1.12	0.90
T_{10}	0.40	0.30	0.58	0.51	1.0	0.60	1.30	1.0	1.63	1.28	1.70	1.31	1.88	1.38
T_{11}	0.30	0.20	0.36	0.30	0.73	0.50	1.20	0.81	1.43	1.10	1.60	1.15	1.70	1.25
T_{12}	0.53	0.38	1.0	0.57	1.52	0.83	1.63	1.00	1.85	1.48	1.88	1.65	2.3	1.90
T_{13}	0.12	0.09	0.14	0.11	0.20	0.14	0.60	0.38	0.66	0.40	0.68	0.60	0.70	0.62
T_{14}	0.10	0.04	0.12	0.10	0.15	0.11	0.52	0.30	0.59	0.35	0.61	0.57	0.64	0.61
S.Em ±	0.01	0.01	0.02	0.02	0.04	0.02	0.18	0.01	0.02	0.02	0.02	0.18	0.28	0.22
C.D.(p=0.05)	0.02	0.03	0.07	0.06	0.10	0.04	0.52	0.04	0.06	0.05	0.07	0.52	0.82	0.64

Legend

T_1 - 100% RDF through soil + humic acid (2%) foliar application
T_2 -100% RDF through soil + 19:19:19 (1%) foliar application
T_3 -100% RDF through soil + Potassium nitrate (1%) foliar application
T_4 -100% RDF through soil + humic acid (2%) + 19:19:19 (1%) foliar application
T_5 -100% RDF through soil + humic acid (2%) + Potassium nitrate (1%) foliar application
T_6 -100% RDF through soil + humic acid (2%) + 19:19:19 (1%) + Potassium nitrate (1%) foliar application
T_7 -75% RDF through soil + humic acid (2%) foliar application
T_8 -75% RDF through soil + 19:19:19 (1%) foliar application
T_9 -75% RDF through soil + Potassium nitrate (1%) foliar application
T_{10} -75% RDF through soil + humic acid (2%) + 19:19:19 (1%) foliar application
T_{11} -75% RDF through soil + humic acid (2%) + Potassium nitrate (1%) foliar application
T_{12} -75% RDF through soil + humic acid (2%) + 19:19:19 (1%) + Potassium nitrate (1%) foliar application
T_{13} -100% RDF through soil application
T_{14} -75% RDF through soil application

Table 2: Influence of humic acid and water soluble fertilizers on stages of bud growth of strawberry (cv. winter dawn)

Treatments	I-II	II-III	III-1V	1V-V	V-VI	VI-VII	VII-VIII	Total days required
T_1	4	3	3	4	4	3	$2^{1/2}$ hours	21
T_2	3	3	3	4	3	2	$2^{1/2}$ hours	18
T_3	4	2	3	4	4	2	2 hours	19
T_4	3	2	2	3	2	2	$1^{1/2}$ hours	14
T_5	3	2	2	3	3	2	2 hours	15
T_6	3	2	2	3	1	1	$1^{1/2}$ hours	12
T_7	4	3	3	3	4	3	$2^{1/2}$ hours	20
T_8	3	2	2	3	3	2	$2^{1/2}$ hours	15
T_9	4	3	2	4	4	2	2 hours	19
T_{10}	3	2	3	3	2	1	2 hours	14
T_{11}	3	2	2	4	2	2	2 hours	15
T_{12}	3	3	2	3	1	1	$1^{1/2}$ hours	13
T_{13}	5	3	4	4	5	4	3 hours	21
T_{14}	5	3	4	4	5	4	3 hours	21
Average	3.57	2.50	2.64	3.50	2.85	2.21	2 hour 17 minutes	16.92

Legend

T_1 - 100% RDF through soil + humic acid (2%) foliar application
T_2 -100% RDF through soil + 19:19:19 (1%) foliar application
T_3 -100% RDF through soil + Potassium nitrate (1%) foliar application
T_4 -100% RDF through soil + humic acid (2%) + 19:19:19 (1%) foliar application
T_5 -100% RDF through soil + humic acid (2%) + Potassium nitrate (1%) foliar application
T_6 -100% RDF through soil + humic acid (2%) + 19:19:19 (1%) + Potassium nitrate (1%) foliar application
T_7 -75% RDF through soil + humic acid (2%) foliar application
T_8 -75% RDF through soil + 19:19:19 (1%) foliar application
T_9 -75% RDF through soil + Potassium nitrate (1%) foliar application
T_{10} -75% RDF through soil + humic acid (2%) + 19:19:19 (1%) foliar application
T_{11} -75% RDF through soil + humic acid (2%) + Potassium nitrate (1%) foliar application
T_{12} -75% RDF through soil + humic acid (2%) + 19:19:19 (1%) + Potassium nitrate (1%) foliar application
T_{13} -100% RDF through soil application
T_{14} -75% RDF through soil application

Table 3: Influence of humic acid and water soluble fertilizers on reproductive parameters of strawberry (cv. winter dawn).

Treatment	Days taken for First flower bud initiation	Days taken for fruit set	Days taken from flowering to berry maturity	Duration of flowering
T_1	62.17	67.10	28.86	61.52
T_2	59.93	64.32	26.88	67.07
T_3	61.20	66.33	27.62	64.41
T_4	56.03	61.29	25.29	69.59
T_5	57.72	63.80	25.43	68.45
T_6	53.83	58.29	23.30	72.90
T_7	62.88	67.30	29.24	60.92
T_8	60.55	64.28	27.17	65.73
T_9	61.88	67.20	28.35	63.19
T_{10}	56.98	61.18	25.34	69.17
T_{11}	58.84	62.20	26.43	67.46
T_{12}	54.12	59.10	23.92	71.88
T_{13}	63.19	68.89	29.70	59.31
T_{14}	65.20	70.40	30.91	58.15
S.Em ±	0.01	0.01	0.16	0.20
C.D.(p = 0.05)	0.03	0.03	0.48	0.60

Legend

T_1 - 100% RDF through soil + humic acid (2%) foliar application
T_2 -100% RDF through soil + 19:19:19 (1%) foliar application
T_3 -100% RDF through soil + Potassium nitrate (1%) foliar application
T_4 -100% RDF through soil + humic acid (2%) + 19:19:19 (1%) foliar application
T_5 -100% RDF through soil + humic acid (2%) + Potassium nitrate (1%) foliar application
T_6 -100% RDF through soil + humic acid (2%) + 19:19:19 (1%) + Potassium nitrate (1%) foliar application
T_7 -75% RDF through soil + humic acid (2%) foliar application
T_8 -75% RDF through soil + 19:19:19 (1%) foliar application
T_9 -75% RDF through soil + Potassium nitrate (1%) foliar application
T_{10} -75% RDF through soil + humic acid (2%) + 19:19:19 (1%) foliar application
T_{11} -75% RDF through soil + humic acid (2%) + Potassium nitrate (1%) foliar application
T_{12} -75% RDF through soil + humic acid (2%) + 19:19:19 (1%) + Potassium nitrate (1%) foliar application
T_{13} -100% RDF through soil application
T_{14} -75% RDF through soil application

Table 4: Anthesis and dehiscence

Treatments	number of flowers observed	6-8 am	8-10 am	10-12 pm	12-2 pm	2-4 pm	Temperature (°C)	Humidity (%)
T_1	15	1	4	9	1	0	17	70
T_2	15	1	4	10	0	0	17	70
T_3	15	2	3	9	1	0	17	70
T_4	15	1	2	12	0	0	18	65
T_5	15	2	2	11	0	0	18	70
T_6	15	0	2	13	0	0	17	65
T_7	15	2	5	07	1	0	16	60
T_8	15	1	5	09	0	0	18	70
T_9	15	1	5	8	1	0	17	65
T_{10}	15	1	2	11	1	0	16	70
T_{11}	15	0	3	10	1	0	18	70
T_{12}	15	1	2	12	0	0	18	65
T_{13}	15	2	4	7	2	0	17	60
T_{14}	15	3	4	6	2	0	17	60
Average	15	1.28	3.35	9.57	0.71	0.00	17.07	66.42

Legend

T_1 - 100% RDF through soil + humic acid (2%) foliar application
T_2 -100% RDF through soil + 19:19:19 (1%) foliar application
T_3 -100% RDF through soil + Potassium nitrate (1%) foliar application
T_4 -100% RDF through soil + humic acid (2%) + 19:19:19 (1%) foliar application
T_5 -100% RDF through soil + humic acid (2%) + Potassium nitrate (1%) foliar application
T_6 -100% RDF through soil + humic acid (2%) + 19:19:19 (1%) + Potassium nitrate (1%) foliar application
T_7 -75% RDF through soil + humic acid (2%) foliar application
T_8 -75% RDF through soil + 19:19:19 (1%) foliar application
T_9 -75% RDF through soil + Potassium nitrate (1%) foliar application
T_{10} -75% RDF through soil + humic acid (2%) + 19:19:19 (1%) foliar application
T_{11} -75% RDF through soil + humic acid (2%) + Potassium nitrate (1%) foliar application
T_{12} -75% RDF through soil + humic acid (2%) + 19:19:19 (1%) + Potassium nitrate (1%) foliar application
T_{13} -100% RDF through soil application
T_{14} -75% RDF through soil application

Floral morphology and Anthesis, dehiscence

Strawberry, a member of the *Rosaceae* family, possesses unique features during the development of leaves and floral organs. The leaves are compound with three leaflets saw tooth edged and hairy. The flowers are generally white borne in small clusters on slender stalks. The flowers contain four typical whorls of floral organs, including five sepals, five petals, 20-30 stamens, and more than 100 unfused carpels from outer to inner (Hollender *et al*., 2012) [21]. The carpels are spirally and individually attached to the receptacle (an enlarged shoot tip) each with one style and one ovule inside the ovary, Anthers yellow, plump dehiscing by two longitudinal sutures, flowers are actinomorphic, sometimes tinged with pink. In some species staminate and pistil ate flowers were readily distinguished, but in others e.g. gynodioceious *Fragaria vesca* subsp. Bracteata the pistil ate flowers had anthers and were very similar to the bisexual ones. Fruit is an aggregate accessory fruit botanically known as etario of achenes, edible portion includes the ripened receptacle and achenes.

The calyx segments were noted to separate out gradually due to the inner pressure of the protruding corolla. On the day of anthesis, the buds became swollen and petals appeared slightly loose. First of all, a small split in the center of the upper portion of corolla was noticed. The splits slowly appeared as adjacent petals were pushed out and it divided the whole compact corolla into two clearly visible portions. After that all the petals continued to stretch out and large portion of stamens and fully expanded pistil became visible. The flowers finally opened exposing all the stamens and fully expanded pistil. The period of anthesis and dehiscence varied from 6 am to 4 pm. peak period of anthesis (50%) having reached between 10 am to 12 pm (13 flowers) in T6-100% RDF + Humic acid (2%) +19:19:19 (1%) + potassium nitrate (1%) foliar application followed by (T12) between 8.00 am to 10.00 am (Table-2) The anthers did not dehisce synchronously, some of these started to dehiscence just after opening of flower which is observed.

Number of flowers, fruits and days taken for bud initiation to fruit set, yield.

Number of flowers from tagged plants were counted till it reached final harvest and average number of flowers per plant was worked out. The number of fruits per plant was counted manually from randomly selected five plants and then the average value was worked out and presented. The result divulged as T6 (100% RDF + HA (2%) + 19:19:19 (1%) + KNO3 (1%) through foliar application) recorded maximum number of flowers per plant (24.74), berries per plant (21.99), yield per plot (4.55 kg) and minimum days taken for bud initiation to fruit set (58.29), which is on par with T12 (24.44), which received 75% RDF + HA (2%) + 19:19:19 (1%) + KNO3 (1%) through foliar application and the minimum number of flowers (16.59), fruits per plant (15.16). yield per plot and maximum days taken for fruit set (70.40) was recorded in T14 (75% RDF through soil application). increase in a number of flowers and fruits in strawberry might be

Table 5: Influence of humic acid and water soluble fertilizers on yield parameters of strawberry (cv. winter dawn).

Treatment	Number of flowers plant^{-1}	Number of berries plant^{-1}	Number of pickings plant^{-1}	Yield per plot (kg)
T_1	17.92	17.29	16	2.41
T_2	21.83	19.32	19	3.30
T_3	19.31	18.15	16	2.90
T_4	23.60	20.65	20	4.37
T_5	22.78	20.01	20	3.89
T_6	24.74	21.99	23	4.55
T_7	17.23	16.93	14	2.32
T_8	21.29	19.00	17	3.15
T_9	18.63	17.91	16	2.71
T_{10}	23.19	20.30	20	4.11
T_{11}	22.36	19.64	18	3.42
T_{12}	24.44	21.94	22	4.48
T_{13}	17.11	16.10	12	2.12
T_{14}	16.59	15.16	10	1.94
S.Em ±	0.28	0.22	0.93	0.06
C.D.(p=0.05)	0.82	0.64	2.70	0.18

Legend

T_1 - 100% RDF through soil + humic acid (2%) foliar application
T_2 -100% RDF through soil + 19:19:19 (1%) foliar application
T_3 -100% RDF through soil + Potassium nitrate (1%) foliar application
T_4 -100% RDF through soil + humic acid (2%) + 19:19:19 (1%) foliar application
T_5 -100% RDF through soil + humic acid (2%) + Potassium nitrate (1%) foliar application
T_6 -100% RDF through soil + humic acid (2%) + 19:19:19 (1%) + Potassium nitrate (1%) foliar application
T_7 -75% RDF through soil + humic acid (2%) foliar application
T_8 -75% RDF through soil + 19:19:19 (1%) foliar application
T_9 -75% RDF through soil + Potassium nitrate (1%) foliar application
T_{10} -75% RDF through soil + humic acid (2%) + 19:19:19 (1%) foliar application
T_{11} -75% RDF through soil + humic acid (2%) + Potassium nitrate (1%) foliar application
T_{12} -75% RDF through soil + humic acid (2%) + 19:19:19 (1%) + Potassium nitrate (1%) foliar application
T_{13} -100% RDF through soil application
T_{14} -75% RDF through soil application.

Due to the humic acid along with NPK nutrients supply through foliar application accelerated development of inflorescence. Potassium nitrate enhances breaking of bud dormancy and increased flowering sites leading to early onset of reproductive stage. The research result is in conformity with the findings Kazemi (2014) [10], Eshaghi and Garazhian (2015) [5], Eshaghi *et al.* (2012) [20] in strawberry and Sudha *et al*. (2012) [18] in mango. Accumulation of higher starch, carbohydrates and photosynthates in better transfer to the sink effected increased number of berries. Together possess synergistic integrity elevated the yield to see most significant level. These results are in line with those of Hagagg *et al.* (2013) [7] in olive, Asgharzade and Babaeian (2012) [1] in grape, Awad *et al*. (2010) [3] in strawberry, Mukunda Lakshmi *et al.* (2014) [13] in citrus and Singh *et al*. (2005) [16].

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