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Research Paper :

Calibration of fertilizer tank

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ABSTRACT

Fertigation is the application of water-soluble fertilizer through irrigation. It is simple in construction and easy to handle than other equipment. Fertizer tank should be calibrated for time require for application of one batch of fertilizer. Advantages of fertigation are to save fertilizer and application of fertilizer to the crop root zone in required quantity and at required time. Fertilizer tank is simple in operation and need not required any external power. Supply of nutrients increases their availability, the wastage of there being leached out to below rooting depth and consequently improves efficient usage in comparison with other methods of application. In present study, twelve plots were selected in the experimental plot with varying concentration of fertilizer. Then samples were tested with the help of flame photometer for determining distribution efficiency. From this the fertilizers were uniformly distributed all over the field.

Key words : Calibration, Fertilizer tank

Fertigation is the application of water-soluble fertilizer through drip irrigation system. Drip irrigation offers the opportunity for precise application of fertilizer to soil because root develops extensively in the restricted volume of soil wetted by drip irrigation. Application of fertilizer through the irrigation system can efficiently place the nutrients in that zone in which roots are of highest concentration.

Fertilizing through irrigation water in drip irrigation is called so far,for two reasons: one is the continuous or almost continuous water supply, directly to the root zone of plant which makes the application of minerals when necessary(and only then), where it is required and in correct quantity this means a saving in materials work prevention of harmful accumulation of minerals in the soil and no plant stress.

Fertilizer can be injected into drip irrigation system by selecting appropriate equipment from a wide variety of available pumps, valves, timers, equipments having inherent merits and demerits. Suction of fertilizer through the intake of pump is a common method of application. However, corrosive fertilizer material will cause pump to deteriorate. In some cases, water pressure on suction side is such that it does not allow the fertilizer solution to flow in to the pump.

Fertilizer tank is another method of injecting fertilizer into drip irrigation systems. The PD units take advantage of systems pressure head differences. Pressure differences can be developed by valves, venturies, elbows or pipe friction. The main advantage of fertilizer tank is absence of moving parts. They are simple in operation and require no external power. They can operate whenever water is flowing and pressure drop is present. The primary disadvantage of fertilizer tank is that the rate of application is not constant and changes continuously with time, thus a uniform concentration of nutrient can not be maintained. Also this system is not portable. However among the available devices of fertigation, fertilizer tank are easy to operate, less costly, requires less maintenance, very little information is available on mode of operation of fertilizer tank, especially as to how the chemical concentration varies with time and period required to flush all the fertilizers into the drip system. Keeping this in view, an experiment was planed to be conducted.

METHODOLOGY

Selection of field and fertilizer: Before starting calibration of fertilizer tank, a plot having four years old citrus (Sweet orange) plants was chosen. In all there were 655 plants located at spacing of 5.5x5.5m.The soil was 1 meter deep categorized as medium black, having almost of uniform slope.

Location:

The experimental plot was located at village Tattu Jawala, Tq. and district Parbhani (M.S.), 10 km from Parbhani and the name of farmer was Vijay Bapusaheb Adkine.

Experimental details:

The experiment was laid for the sweet orange and

calibrated for fertilizer tank. Following treatments were given,

- Fertilizer levels(C):C_1,C_2,C_3
- Operating pressure(P):P_1, P_2, P_3
- Replications:3
- Design: RBD

The fertilizer doses (C) were selected as: C_1=20kg, C_2=15kg, C_3=10kg. The operating pressure of system was maintained at P_1=2.2kg/cm^2, P_2=1.5 kg/cm^2, P_3=1.0 kg/cm^2.

The observation for each point, well distributed over the field was randomly selected for observation on discharge rate and concentration of fertilizer being applied in the field. The elevations of the selected emitter points were determined with the help of dumpy level.

Time of emptying fertilizer:

Red colour of different concentrations was added in the fertilizer tank and time requires for total displacement of colour from tank was recorded at different pressure. 10g, 6g, 4g of colour was allowed to flow from the tank outlet sections. At same pressure difference (0.2kg/cm^2), the data on emptying fertilizer tank at different concentration and pressure is presented in Table 1.

Table 1 : Time required for colour of different colour levels and pressure levels in minutes

	P_1	P_2	P_3
C_1=10 g	78	80	85
C_2= 6 g	68	70	72
C_3= 4 g	45	49	55

Therefore, the water samples from the emitters were collected at 30 minutes, 60minutes and 90 minutes after starting the system, thinking that a single batch of fertilizer is completely applied in the field within 90 minutes.

Each batch of fertilizer as determined in the experimental layout was administrated into the fertilizer tank and observations were recorded with respect to uniformity of nutrient distribution and overall uniformity of drip system. First of all total flow of the pump was diverted to the experimental plot till the maximum pressure (2.2kg/cm^2) was obtained at the inlet pressure gage. Then the flow was allowed to be filled to ¾ of its capacity. The predetermined dose of fertilizer was added to the tank and stirred thoroughly for 5-10 minutes until the entire fertilizer was dissolved in the water. The man hole was closed and inlet and outlet valves opened as soon as the tank was full of water, the solution started flowing through the outlet transparent pressure pipe for about 20 minutes and sufficient back pressure developed in the outlet pipe of tank which was indicative of starting the drip system all over the field. The discharge from the selected emitter was collected in the catch cans for 4 minutes, three times for each batch of fertilizer and pressure. The volume collected in the catch cans was measured with help of measuring cylinder. All the observations were taken for 9 events.

Nutrient analysis:

The water samples collected from the selected emitters were analyzed for potassium concentration in the laboratory with the help of flame photometer. Standard procedure for determination of K_2O concentration was used. For each batch of fertilizer and pressure, water samples were collected at 30minutes, 60minutes and 90 minutes after starting the system. Same procedure was repeated for the all doses of fertilizer (C_1, C_2 and C_3) and pressure (P_1, P_2 and P_3).

Statistical analysis:

The data obtained on discharge and nutrient concentration were analyzed statistically using randomized block design (RBD) and /Factorial Randomized Block Design (FRBD) techniques.

The distribution efficiency of the nutrient and emitter discharge were calculated by following formula,

$$E_d = (1 - d/y) \times 100$$

where

E_d-Distribution efficiency

d –Mean emitter flow rate

y - Average numerical deviation from d

RESULTS AND DISCUSSION

The results of present investigation inferred on the basis of statistical analysis of data collected on different parameters.

Pressure	time	fertilizer levels
P_1=2.2kg/cm^2	T_1=30min.	C_1=20 kg
P_2=1.5 kg/cm^2	T_2=60min.	C_2=15 kg
P_3=1.0 kg/cm^2	T_3=30min.	C_1=20 kg

Effect of concentration and discharge:

Effect of pressure on concentration (ppm) and discharge (lph) are presented in Table 2. The data revealed that, the effect of pressure on concentration and discharge were significant.

Concentration:

The effect of different pressure P_1 recorded

Table 2 : Effect of pressure on concentration (ppm) and discharge(lph)

Pressure	Concentration (ppm)	Discharge (lph).
P_1	256.52	7.3393
P_2	113.94	6.5451
P_3	144.42	4.9034
S.E.±	2.5951	0.025349
CD	7.7879	0.070154
CV	9.072	2042
G. Mean	171.63	6.26

significantly higher concentration than P_2, P_3. Similarly P_3 pressure recorded significantly for more concentration.

Discharge:

The effect of different pressure on discharge was significant. The rate of discharge reduced with decrease in pressure.

Effect of fertilizer levels on concentration and discharge:

The data on effect of fertilizer levels on concentration and discharge are presented in Table 3. The effect of fertilizer on concentration as well as discharge was significant.

Table 3 : Effect of fertilizer levels on concentration and discharge

Fertilizer level	Concentration (ppm)	Discharge (lph).
C_1	236.43	6.226
C_2	140.99	6.2125
C_3	137.46	6.3094
S.E. ±	2.5951	0.025341
CD	7.1819	0.070154
CV	9.071	2.42
G. Mean	171.63	6.26

Concentration:

C_1 levels of fertilizer was significant over C_2 and C_3 was non significant.

Discharge:

The discharge rate under C_3 level of fertilizer was significantly higher than C_1 and C_2 fertilizer levels. However difference between C_1 and C_2 was not significant (Table 5).

Effect of time on concentration and discharge:

The data on effect of time on concentration and discharge are presented in Table 4. Perusal of data presented in Table 4 revealed that the time effect on concentration as well as discharge was significant.

Table 4 : Effect of time on concentration and discharge

Time(min.)	Concentration (ppm)	Discharge (lph).
T_1	174.68	6.44
T_2	241.83	6.22
T_3	162.65	6.09
S.E. ±	4.28	0.05439
C.D. (P=0.05)	11.86	0.1643

Table 5 : Water distribution efficiency as affected by concentration and pressure

Fertilizer level	P_1	P_2	P_3
C_1	91.61944	98.33896	94.06321
C_2	97.68763	95.97172	94.63972
C_3	97.78362	95.96825	90.78461
Average efficiency	95.69%	96.76%	93.16
Overall efficiency		95.69%	

Concentration:

The time T_2 recorded significantly higher concentration than T_1 and T_3. Similarly T_1 was significantly superior to T_3.

Discharge:

The discharge rate at T_1 was significantly higher than T_2 and T_3. But the difference between T_2 and T_3 was not significant.

Effect of elevation difference on distribution efficiency:

The data in the Table 6 showed that, the elevation difference between selected emitter ranged between 100 and 106.6 m. though there was considerable elevation difference. The overall distribution efficiency did not hamper.

Similar type work in the past was conducted by Kolhe and Potghan (1997) and Micha and Aapir (1986).

Conclusion:

The fertilizer tank of 160 liter capacity (7.33m^3/h) was calibrated for three pressure (P_1>P_2>P_3), three fertilizer levels (C_1>C_2>C_3) and three times (T_1<T_2<T_3).

Following conclusions were drawn from the study;

– The amount of fertilizer added (fertilizer levels) to the tank was not evacuated completely within the observation time of 90 minutes, indicating that the fertilizer levels tried in this experiment requires more than 90 minutes for complete exhaustion of fertilizer from the tank.

Table 6: Reduced levels of randomly selected emitter points

Emitter points	A	B	C	D	E	F	G	H	I	J	K	L
R.L.B.M.	99.985	99.975	100.15	100.61	100.455	100.355	100.655	101.375	101.465	101.485	101.485	101.595

– The mixing of fertilizer solution in the main line flow was not uniform during application of batch of fertilizer. The concentration of nutrient (K)of irrigation water was in concurrent with operating time.

– The fertilize was applied to all the plants in the field with ± 4 per cent variation. Therefore, fertilizer tank can be efficient for the application of plant nutrients and chemicals.

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