Int.J.Curr.Microbiol.App.Sci (2020) *9*(4): 1925-1935

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 9 Number 4 (2020)**
Journal homepage: http://www.ijcmas.com

Case Study

https://doi.org/10.20546/ijcmas.2020.904.229

To Compare the Utilization of Fertilizer through Drip, Micro Sprinkler and Conventional (i.e. Check Basin) Irrigation Methods in Litchi Plants Inter-Cropped with Garlic and Onion

Meera Kumari[1]*, Hemant Kumar[2] and Avanish Yadav[3]

[1]Department of Agriculture Engineering, Tirhut College of Agriculture, Dholi, RPCAU, Pusa, Samastipur, Bihar, India
[2]College of Forestry, SHUATS, Allahabad, UP, India
[3]Soil Water Engineering, SHUATS, Allahabad, UP, India

**Corresponding author*

Keywords

Dri irrigation, Micro sprinkler irrigation, Check basin irrigation, Compare between different irrigation systems, Utilization of fertilizer, Benefit – cost ratio of Onion and Garlic

Article Info

Accepted:
15 March 2020
Available Online:
10 April 2020

A B S T R A C T

The research work entitled "To compare the utilization of fertilizer through drip, micro sprinkler and conventional (i.e. check basin) irrigation methods in litchi plants inter – cropped with Garlic and Onion." was carried out under three main treatments on Irrigation methods namely; drip, micro sprinkler and traditional irrigation method (Check basin), three sub main treatments. i.e. without intercrop and inter-cropped with garlic and onion crops, with three replications. Based on the harvested database, it was found that the growth parameters of litchi plants were significantly greater in case of drip Irrigation along with 100% fertigation, followed by micro-sprinkler irrigation and traditional method. The lowest response was observed when irrigation was applied through drip without fertigation. The fertilizer use in respect of plant growth was evaluated to be maximum i.e.,60.50cm/quintal in treatment T_2 (application of irrigation and fertigation through drip irrigation system) and lowest 50.50cm/quintal in T_4 (application of irrigation and fertigation through traditional method). The maximum benefit – cost ratio was estimated to the tune of 5.20 for garlic crop and 6.30 for Onion crop under treatment T_3 (application of irrigation and fertigation through micro irrigation system). Phenological growth of litchi plants was not significant. The fertilizer use in respect of plant growth was evaluated to be maximum i.e.,60.50cm/quintal in treatment T_2 (application of irrigation and fertigation through drip irrigation system) and lowest 50.50 cm/quintal in T_4 (application of irrigation and fertigation through traditional method). The maximum benefit – cost ratio was estimated to the tune of 5.20 for garlic crop and 6.30 for Onion crop under treatment T_3 (application of irrigation and fertigation through micro + irrigation system).

Introduction

The traditional method adopted by farmers for application of fertilizers has many disadvantages in terms of fertilizer wastes due to leaching, fixing, volatilizes or in one word "poor efficiency". In the situation, when prices of fertilizers are ever increasing, the adopting of precise and efficient method of fertigation has become imperative. With technology revaluation and development of Hi-tech in agriculture, in most of the advance countries, like Israel, USA, inland etc, the new concept of fertilization has become a standard practice of fertilizer application to numerous crops.

Today India is at 7th rank in terms of coverage area under drip irrigation i.e. 10.30mha, in which 0.82mha for fruit crops only (Anonymous, 1999). From the last decade the term "fertilization" is introduced with the micro irrigation, which is coined with two words i.e. fertilizer and irrigation, indicating application of fertilizer along with irrigation water. The success of fertilization depend not only on good irrigation and proper use of equipments, but also on adequacy of crop water requirements, soil moisture characteristics and crop physiology to enable accurate irrigation scheduling and in turn to maximum water use efficiency. Fertilization increases the availability and uptake of nutrients to the crop as the compared to broadcast application (Bakker *et al.,* 1984).

Amongst different methods of fertilization, fertilization through micro - irrigation is the most efficient for horticultural crops. Drip/trickle or micro-spray jets etc. and grounded under one heading i.e. micro irrigation system (MIS) is basically precise and slow applicator of water and fertilizer in the form of discrete and continuous drops into the root zone of the plant, according to consumptive use of the plants demand through mechanical device called emitters.

The micro-irrigation system enables to apply the fertilizers along with water in the root of the plant, daily without any kind of loss. It has been reported that more than 40 per cent saving of fertilizer can be obtained by drip fertilization with substantial increase in yield (Magar, 1988). Water can also be saved ranging from 39 to 62 per cent along with increase in productivity. The efficiency by traditional method is hardly 30 to 50 per cent because of greater of loss due to nitrification, ammonia volatilization, and leaching and surface runoff. One the contracts, these are minimized to a large extent by micro irrigation.

In India litchi (litchi china) ranks second in the world, next to the china in the production. The area and production of litchi during 1998-99 was reported to be 0.56 lakh t/ ha and 4.29 lakh t/ha respectively, which is about 1.5 per cent of the total area in 0.97 percent of the total production of fruits. The production of litchi in India has been estimated to be about 0.41 million tons during 2001 – 2002 (Anonymous, 2002) furthermore, the India is the world's second largest producer of vegetable. Onion (Allium cepa) is believed to have originated in the North – East. The present production of onion of India is about 49 lakh t/ha (1999-2000). In spices sector is also one of the key areas, in which India has an inherent strength to dominate the global market. The present annual production of spices in the country is 3.0 million tons from 2.5 M ha area (Peter and Nybe, 2002). Garlic (*Allium sativum* L.) is the major commercial spice crop, which occupies a prominent position amongst and condiments. Agro – techniques play an important role in the production of garlic, which very much depends on the size of clove, and soil management.

In calcareous belt of north Bihar, amongst various fruit crops, the Litchi is one of the main crops. About 21000 hectares of land are

under litchi cultivation. The average yield is reported as 12 t/ha, which is less as compared to the other parts of the country. It requires increasing by making a change in package and practices of litchi cultivation. Various research findings revealed that, the through drip system has been proved to be an efficient technique in terms of water saving, increase in yield along with quality of produce in wide range of horticultural, commercial crops as well. Furthermore, under the concept of mixed cropping system to utilize the inter space of fruit cropped areas and thus to increase benefit cost ration of the crop, is also being seriously considered for practice in modern agriculture.

Keeping aforesaid views, a research topic, entitled "To compare the utilization of fertilizer through drip, micro sprinkler and conventional (i.e. check basin) irrigation methods in litchi plants inter – cropped with Garlic and Onion".

Materials and Methods

The field experiment was carried out near under the research scheme entitled" precision Farming development financed by N.C. P. H., ministry of agriculture, college of Agriculture Engineering, RPCAU, Pusa (Samastipur), Bihar. Under this study, the main crop was taken as litchi (variety: shahi). Total 40 plants were transplanted at the 6m x 6m spacing. For transplantation of litchi plants, the pits in the size of 1 m x 1 m x 1 m were dug. Before transplanting the litchi plants, 20 kg compost, urea, S.S.P and M.O.P at the rate of 100 g, 200g and 200g, respectively were mixed in the dug soil and filled into the pit. Fortnightly observation were taken on phonological parameters of litchi plants i.e. plant height, plant girth and canopy area (N-S and E-w). In case of intercrops i.e. garlic and Onion, the weekly observation biometrical parameters, such as plant height and number of leaves were collected.

The garlic (var: swati) and onion (var: n- 53) were grown in the interspaces of litchi transplantation. The spacing of onion was kept as 10cm x15cm (row to row and plant to plant), whereas for garlic crop it was 15cm x 15cm. Total 12 treatments and 3 replication were applied for application of irrigation and fertigation to the crops. Three plants per treatment were considered. The details of applied treatments are given as under:

T_1C_1: drip irrigation with Litchi Planst without fertigation without intercrop.

T_2C_1: drip irrigation with Litchi Plants with 100% fertigation without intercrop.

T_3C_1 : micro (sprinkler) irrigation with Litchi Plants with 100% basal application of fertilizers without intercrop.

T_4C_1: traditional irrigation (check basin) with Litchi Plants with 100% basal application of fertilizers without intercrop (i.e. Control treatment).

T_1C_2: drip irrigation without fertigaion, (Litchi Plants) inter -cropped with garlic.

T_2C_2: drip irrigation with 100% basal (Litchi Plants) inter -cropped with garlic.

T_3C_2: micro (sprinkler) irrigation with 100% basal application of fertilizers, Litchi Plants intercropped with garlic.

T_4C_2: traditional irrigation (check basin) with 100% basal application of fertilizers, (Litchi Planst) intercropped with garlic.

T_1C_3: drip irrigation without fertilizers, (Litchi Plants) intercropped with onion.

T_2C_3: drip irrigation with 100% fertigation, (Litchi Plants) intercropped with onion.

T_3C_3: micro (sprinkler) irrigation with 100% basal application of fertilizers, (Litchi Plants) intercropped with onion.

T_4C_3: traditional irrigation (check basin) with 100% basal application of fertilizers, (Litchi Plants) intercropped with onion.

The daily water requirement of litchi plants

and intercrops was computed by using the following formula, suggested by N.C.P.A& H.

V =Ep x Kc x Kp x Wp x Sp ……(1)

Ep =pan evaporation, mm/day, V =water requirement (1 pd/plant), Kc =crop factor of crop coefficient, Kp = pan factor, Wp = wetted area factor, Sp = spacing of crops / plant (m^2)

The value of crop co-efficient (i.e. Kc) for litchi plant was taken as 0.65 for initial growth stage. For Garlic, it was considered 0.45, 0.7, 0.95, 0.82 and 0.75 for initial, development, mid season, late season and harvesting stages, respectively. Similarly, for Onion, the values of Kc were taken as 0.50, 0.75, 1.0, 0.87 and 0.8 for initial, development, mind season, late season and harvesting stages, respectively (FA0, irrigation and Drainage paper, vol-33, 1979). The pan factor (K_p) was taken as 0.8 (FAO, 1979). The wetted area factor (Wp) was taken as 0.3 for widely spaced crop (i.e. litchi) and 0.9 for closely spaced crop (i.e. Garlic and Onion) Anonymous, 1996), As per geometry, the spacing of litchi crop (Sp) per plant (m^2) was considered as 36 m^2 and in case of Garlic and Onion; it was considered as 0.0225 m^2 and 0.015 m^2, respectively. The fertilizer utilization by the crop were evaluated in terms of Fertilizer Use Efficiency (F.U.E.), which is the ratio of yield to the unit amount of fertilizer applied (quintal of yield per quintal of fertilizer). For litchi plants, the fertilizer utilization was evaluated in respect of magnitude of increased plant height per unit of application of fertilizer amount under different treatments.

In case of intercrops i.e. Garlic and onion, the F.U.E. was evaluated based on yield per unit amount of fertilizer application, as both of these crops have their harvested yield. The variations in fertilizer uses under different treatments were determined in respect to the control treatment.

Results and Discussion

Major finding

Details of various finding on the research work entitled "To compare the utilization of fertilizer through drip, micro sprinkler and conventional (i.e. check basin) irrigation methods in litchi plants inter – cropped with Garlic and Onion "under sub headings:-

Fertilizer use growth under different irrigation methods

The estimated fertilizer use for litchi plants under different treatments are shown in Table 1, which revealed that the maximum fertilizer use growth of 60.50 cm/quintal was found in treatment T_2 (application of irrigation and fertigation through drip irrigation system), followed by 57.02 cm/quintal in T_3 (application of irrigation and fertigation through micro irrigation system), and lowest 50.50 cm/quintal in T_4 (application of irrigation and fertigation through traditional method).

Litchi intercropped with garlic

As shown in Table 1, it was observed that in case of intercropping system, the fertilizer use growth was maximum in treatment T_2C_2 (application of irrigation and 100% fertigation through drip irrigation system) to the rate of 60.5 cm/quintal and minimum 50.0 cm/quintal in treatment T_4C_2 (irrigation through traditional method + 100% basal application of fertilizers). In other treatment, i.e. T_3C_2 (application of irrigation micro-irrigation system + 100% basal application of fertilizers), the fertilizer use growth was estimated to be 56.4 cm per quintal of fertilizer application.

Table.1 Estimated fertilizer use efficiency of litchi plants under different treatments

Treatment	Fertilizer applied (q/ha)	Depth of water applied (cm)	Plant height (cm)	Increase in plant height over.	Fertilizer use efficiency (cm per q of fertilizer use)
T1C1	-	4.15	21.20	-8.1	-
T2C1	0.50	4.15	30.25	19.80	60.50
T3C1	0.50	4.15	28.51	12.9	57.02
T4C1	0.50	4.15	25.25	-	50.50
T1C2	-	4.15	22.75	-9.0	-
T2C2	0.50	4.15	30.25	21.0	60.50
T3C2	0.50	4.15	28.20	12.8	56.40
T4C2	0.50	4.15	25.00	-	50.00
T1C3	-	4.15	22.73	-8.75	-
T2C3	0.50	4.15	30.30	21.60	60.60
T3C3	0.50	4.15	28.15	12.9	56.30
T4C3	0.50	4.15	24.91	-	49.82

Table.2 Estimated fertilizer use efficiency of garlic and onion crops under different treatments

Treatment	Fertilizer applied (q/ha)	Depth of water applied (cm)	Yield (q/ha)	Increase in yield over control (%)	Water use efficiency (q/ha/cm)	Fertilizer use efficiency (q per quintal fertilizers)
T1C2	-	13.23	88.30	-15.74	6.67	-
T2C2	7.25	13.23	128.30	13.68	9.69	17.69
T3C2	7.25	13.23	132.30	27.50	10.00	18.24
T4C2	7.25	13.23	101.40	-	7.60	13.98
T1C3		13.98	180.67	-22.88	12.92	-
T2C3	7.60	13.98	330.55	38.57	23.64	43.49
T3C3	7.60	13.98	370.17	53.53	26.63	48.70
T4C3	7.60	13.98	240.21	-	17.18	31.60

Table.3 Effect of irrigation methods on plant height of Garlic& Onion under different treatment

Main treatment	Sub treatment			Percent variation over control treatment
	C2	C3	C2	C3
T1	49.57	49.37	-4.78	-4.23
T2	65.35	65.23	25.53	26.54
T3	67.90	67.78	30.43	31.48
T4	52.06	51.55	-	-
Mean of sub – treatment	61.77	61.52		
	S.Em	C.D. (AT 5%)	C.V	. F.value
Main treatment	2.216181	5.422995	4.625194	36.066 (significant at 1 and 5% levels)

Table.4 Effect of irrigation methods on average number of leaves in garlic and onion under different treatments & percentage variation in average number of leaves in Garlic and Onion crops under different treatments over control

Main treatment	Sub treatment			Percent variation over control treatment	
	C2	C3		C2	C3
T1	8.97	8.67		-3.76	-12.69
T2	11.34	12.39		21.67	23.77
T3	12.18	12.83		30.69	29.20
T4	9.32	9.93		-	-
Mean of sub – treatment	10.95	11.72			
S.Em	C.D. (AT 5%)		C.V	. F.value	
Main treatment	0.6309935	1.544041	7.22727	15.398 (significant at 1 and 5% levels)	

Table.5 Effect of irrigation methods on diameter of garlic and Onion of bulbs (cm) under different treatments

Main treatment	Sub treatment			Percent variation over control treatment
	C1	C2	C3	
T1	2.22	2.56	-27.45	-34.53
T2	3.67	4.67	19.93	26.34
T3	4.12	5.11	34.64	30.69
T4	3.06	3.91	-	-
Mean of sub – treatment	3.62	4.66		
S.Em	C.D. (AT 5%)		C.V	F. value
Main treatment	0.13723	0.335822	4.541229	104.823 (significant at 1 and 5% levels)

Table.6 Effect of irrigation methods on average weight of Garlic and onion bulbs (gram) under different treatments

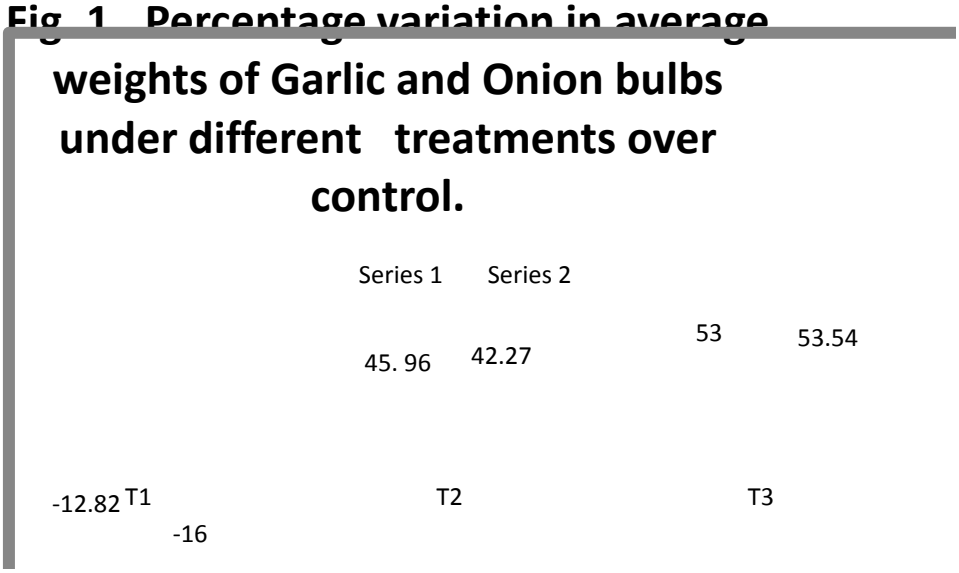
Main treatment	Sub treatment			Percent variation over control treatment	
	C2	C3		C2	C3
T1	13.26	30.50		-12.82	-16.00
T2	22.20	51.66		45.96	42.27
T3	23.27	55.75		53.00	53.54
T4	15.21	36.31		-	-
Mean of sub – treatment	20.23	47.91			
S.Em	C.D. (AT 5%)		C.V	. F.value	
Main treatment	1.280784	3.134079	5.056983	88.688 (significant at 1 and 5% levels)	

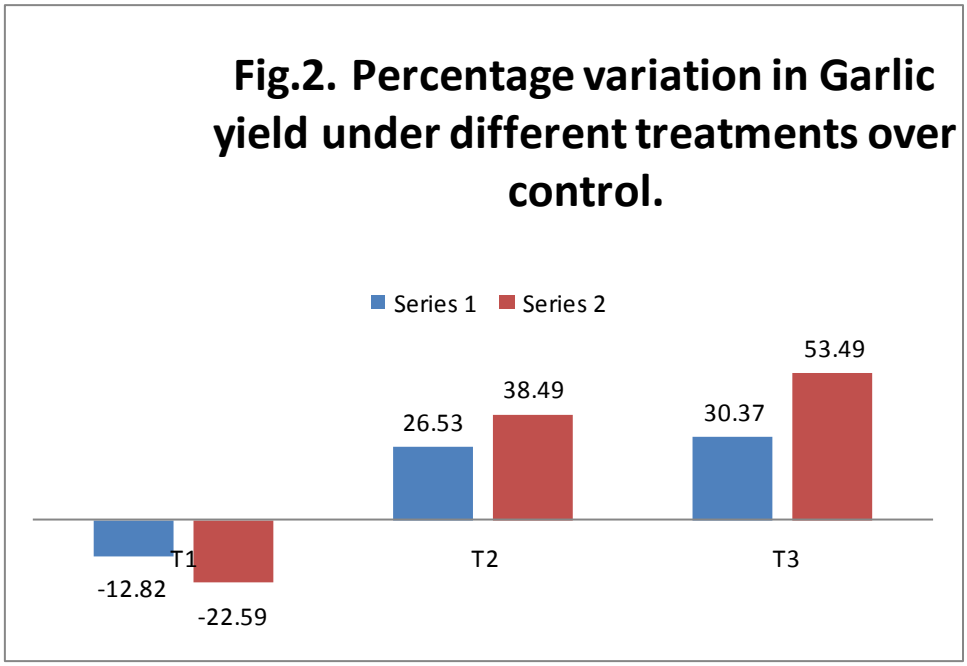
Table.7 Effect of irrigation methods on yield (t/ha) of Garlic and Onion crops under different treatments

Main treatment	Sub treatment			Percent variation over control treatment	
	C2	C3		C2	C3
T1	8.83	18.74		-12.92	-22.59
T2	12.83	33.45		26.53	38.17
T3	13.22	37.16		30.37	53.49
T4	10.14	24.21		-	-
Mean of sub – treatment	12.06	31.61			
S.Em		C.D. (AT 5%)		C.V	. F.value
Main treatment	1.16669	2.85489	7.208312	40.811 (significant at 1 and 5% levels)	

Table.8 Estimated benefit - cost ratio of Garlic and Onion (inter crops) crops under different treatments

Particular	Crop							
	Garlic / Treatment				Onion / Treatment			
	T1C2	T2C2	T3C2	T4C2	T1C3	T2C3	T3C3	T4C3
Fixed cost, Rs	2,600	2600	2100	-	2600	2600	2100	-
System operating cost, Rs	3,000	3000	2500	-	3500	3500	3000	-
Cultivation cost, Rs	18,500	24500	24500	29000	19700	25200	25200	30400
Total seasonal cost, Rs	24,100	30100	29100	29000	25000	31300	30300	30400
Yield, q/ha	88.30	128.30	133.20	114.70	186.70	335.50	371.90	242.10
Cost price Rs / q	1150	1270	1370	1200	500	540	600	520
Income, Rs	101545	162941	182484	137640	93350	149870	223140	125892
B/C ratio	3.20	4.41	5.20	3.74	2.70	3.70	6.30	3.14





Litchi intercropped with onion

The maximum fertilizer use growth i.e.60.60 cm /quintal was found in treatment T_2C_3 (Application of irrigation and 100% fertigation through drip irrigation system) and minimum 49.82 cm/quintal in treatment T_4C_3 (Application of irrigation and fertigation through traditional method). The fertilizer use growth. In treatment T_3C_3 was found to the tune of 56.30 cm/quintal of fertilizer application (Table 1).

Fertilizer use efficiency for garlic and onion crops

Table 2 refers to the estimated F.U.E. for Garlic and Onion crops under different treatment, which revealed that in case of Garlic crop, the maximum F.U.E. i.e. 18.24 q per quintal fertilizer was found under treatment T_3C_2(irrigation through Micro sprinkler system + 100% basal application of fertilizer fertigation), followed by 13.98 inT_4C_2 (irrigation through traditional method + basal application of fertilizers) and minimum i.e. 17.96 in treatment T_2 C_2 (irrigation and 100% fertigation through drip irrigation system).

In case of onion crops (from Table 2), the highest F.U.E. was estimated for treatment T3C3 (application of irrigation and fertigation through micro irrigation system) to the rate of 48.7 q per q fertilizer. And lowest i.e.31.60 q per q fertilizer was found for treatment T_4C_3 (irrigation through traditional method + 100% basal application of fertilizers).In treatment T_2C_3, it was 43.49q per quintal of fertilizer application.

Effects of Irrigation Method on Phenological Characteristics of Intercrops

The effect of different irrigation methods on phenological characteristics, such as plants height, number of leaves, bulb size (diameter) and yield parameters including the weight of bulb and average yield of the Garlic and onion crops were evaluated.

Plant height of garlic &onion

The effect of irrigation method on plant

height of both intercrops is presented in Table 3. The maximum average height of Garlic plants was observed in treatment T_3 C_2 (application of irrigation through micro sprinkler system + 100% basal application of fertilizers) to the tune of 67.9 cm, while minimum 49.57 cm in treatment T_1C_2 i.e. application of irrigation through drip without fertigation (Figure 1). While in case of Onion (from Table 3) the maximum height of onion plant (67.78 cm) was in treatment T_3 C_3 (application of irrigation through micro sprinkler system+100% basal application of fertilizers), while minimum of 49.37 cm was in treatments T_1 C_3 (application of irrigation through drip system without fertigation). On contrary to this, in treatment T_1C_3 (application of irrigation through drip system without fertigation) the plant height was 4.23 % less as compared to the control treatment. In case of both intercrops, the effect of micro-sprinkler irrigation was found to be more effective to that of drip and traditional check

Number of leaves of garlic and onion

The effect of irrigation methods on production of functional leaves of intercrops is presented in table 4. The maximum average number of leaves of Garlic (12.18) was found in treatment T_3 C_2, followed by 11.34 in T_2C_2 and 9.32 in T_4 C_2, while a minimum of 8.97 was noticed in treatment T_1C_2. Can be seen that the micro- sprinkler irrigation with 100% basal application of fertilizer could produce 30.69 % more leaves followed by drip irrigation with 100% fertigation. This behaviour may be due to application of irrigation water more uniformity to entire crop of the field. This behaviour may be due to application of irrigation water more uniformity to entire crop of the field and is in conformity with the results reported by Gorantiwar *et al.*, (1988) and Patel *et al.*, (1990).

Bulb size (diameter) of garlic and onion

The effect of irrigation methods on bulb (diameter) of Garlic (Table 5). It can be seen that the application of water through micro-sprinkler system+100% basal application of fertilizers resulted maximum size (diameter) i.e. 4.12 cm, while minimum size of bulb (2.22 cm) was noticed under treatment T_1C_2(application water through drip without fertigation). The effect of irrigation methods on the size of Onion bulbs is more pronounced in treatment T_3 C_3 (micro-sprinkler irrigation with 100% basal application of fertilizers) as compared to other treatments. The percentage variations in size of Onion bulbs over control treatment (T_4 C_3) were found to be 30.69 and 26.34 % higher in treatments T_3C_3 and T_2 C_3, respectively. On the other hand in treatment T_1 C_3 it was 34.53% less over control treatment.

Weight of garlic bulb & onion bulb

The average weights of Garlic bulbs and their variations under different treatments are presented in Table 6. On compression, it was found that amongst all the treatments applied for irrigation, the treatment of micro - sprinkler irrigation along with 100% basal application of fertilizers resulted the maximum weight of bulb i.e. 23.27 g, whereas minimum weight of bulb (13.26 g) in treatment T_1C_2 (application of water through drip system without fertigation). Average weights of onion bulbs under different treatments are given in Table 6, which revealed that the maximum bulb weight (55.75g) was harvested in treatment T_3c_3 (application of irrigation through micro sprinkler system + 100% basal application of fertilizers) while in treatment T_1C_3 (application of irrigation through drip system without fertigation), it was minimum to the tune of 30.50 g.

Yield of intercrops (Garlic and Onion)

The effect of irrigation methods on response of yield of Garlic along with percent variation over control treatment is presented in table 7. it was found that the highest yield (13.32t/ha) was found in treatment T_3C_2 (application of irrigation through micro sprinkler system + 100% basal application of fertilizers), followed by 12.83 t/ha in treatment T_2C_2 (application of water through drip system + 100% fertigation. The percent variations in the yield of garlic

Under different treatments as compared to the control treatment are shown in figure 2 which reveals that about 30.37 % higher yield could be obtained in micro -

Sprinkler irrigation with 100% basal application of fertilizers, followed by 26.53 % in the treatment T_2C_2. While in case of Onion Amongst different treatments, the highest yield at the rate of 37.16 t/ha was harvested in treatment T_3C_3, followed by 33.45 t/ha in T_2C_3, 24.21 t/ha in T_4C_3 and lowest 18.74 t/ha in treatment T_1C_3 (Table 7). As compared to the control treatment, the increase in yield in treatment T_3C_3 was estimated as 53.49% and 38.17% in treatment T_2C_3, while in treatment T_1C_3, it was about 22.59% less over control treatment (Figure 2). Other research workers have also reported similar findings (Gorantiwar *et al.*, 1988 and patel *et al.*, 1990) for response of irrigation methods.

The statistical presented in table 7 revealed that the yields of intercrops under different treatments irrigation methods are significant at 1 % level, having the F value to the tune of 40.811.

Benefit - cost ratio

The estimated benefit - cost ratio for garlic and onion crops (intercrop) under different treatments is given in Table 8 on comparison, it was found that in case of intercropping with garlic, the maximum benefit - cost ratio was found as 5.20 in treatment T_3C_2 (application of irrigation and fertigation through micro irrigation system), followed by 4.41 in treatment T_2C_2 (application of irrigation and fertigation through drip irrigation), 3.74 in treatment T_4C_2 (application of irrigation and fertigation through traditional method) and lowest 3.20 in treatment T_1C_2 (application of irrigation through drip system without fertigation).

Similarly, in case of onion crop, the maximum benefit-cost ratio was found in treatment T_3C_3 (application of irrigation and fertigation through micro irrigation system) as 6.30, while minimum 2.70 in treatment T_1C_3 (application of irrigation through drip system). In treatments T_2C_3 (application of irrigation and fertigation through drip system), and T_4C_3 (application of irrigation and fertigation through traditional method), the benefit - cost ratio was estimated to be 3.70 and 3.14, respectively.

References

Anonymous (2002-2003). Annual report on P.D.C. scheme, R.A.U. Pusa (samastipur) submitted to NCPAH, MOA, and New Delhi.

Koen F,J., W. Langenergger and G. Smart (1981). Nitrogen Fertigation of litchi trees, subtropica, Vol. 2(7), En. Citrus and subtropicl Farm Research Institute Information. Bulletin, 107,Pp9-11.

Kumar, R., S.S Singh and V.K. Rao (2002). Response of Garlic (alliums. SativumL.) to various levels of Nitrogen, Phophorus. Progressive Horticulter. Vol.34(2), Pp 218-22.

Prasad RN, Bankar GJ, Vashishtha BB (2003). Effect of drip irrigation on

growth, yield and quality of pomegranate in arid region. Ind. J. Hort. 60:140-142.

Saleh, A.L, AA Abd El-Kader and Hegab, S.A.M(2003). Response of Onion to organic fertilizer under irrigation with saline water. Egypt Journal of Applied Science 18 (12B):707-716

Shirgure PS, Srivastava AK, Singh S (2001). Growth, yield and quality of Nagpur mandarin *Citrus reticulate* Blanco) in relation to irrigation and fertigation. Ind. J. Agric. Sci. 71:547-550

Salvin S, Baruah K, Bordoloi SK (2000). Drip irrigation studies in banana cv. Barjahaji (*Musa* AAA group, *Cavendish s*ub-group). Crop Res. 20:489-493.

Sankar- V; MA –Qureshi; Tripathi, PC and KE, Lawa –de. (2001). Micro – irrigation studies in Garlic (Allium Sativum L.) – Changing Scenario in the production system of hoticultral crops. Proceedings of a National Seminar, coimbatire, Tamil Nadu, IndiaVol. 49 : special, pp379-381.

Valdovinos carsenas, J.M.(1986). Nitrogen fertilization and planting layout in Garlic Hort. Abset. 56(9): 6858 C.F. Hort. Science 23: 182-186).

Yadav, R.L.; N.L. Sen, M.S. fageria and R.s. Dhaka.(2003). Effect of nitrogen and potassium fertilization on quality bulb production if onion. Haryana J. Hot. Sci. 31(3&4).Pp.:297-298.

How to cite this article:

Meera Kumari, Hemant Kumar and Avanish Yadav. 2020. To Compare the Utilization of Fertilizer through Drip, Micro Sprinkler and Conventional (i.e. Check Basin) Irrigation Methods in Litchi Plants Inter – Cropped with Garlic and Onion. *Int.J.Curr.Microbiol.App.Sci.* 9(04): 1925-1935. doi: https://doi.org/10.20546/ijcmas.2020.904.229