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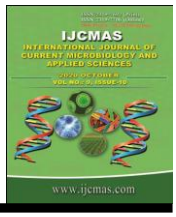

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Effect of Whey on the Growth of Seedlings of some Cereals and Pulses Seeds

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A B S T R A C T

The rate of growth of seedling, the rate of increase of root, shoot, area of the first leaf and the dry weight of the crop plant was faster due to treatment of the seed with whey in comparison to the untreated control. Other parameters may also be incorporated such as increase in the number of cells and biochemical content of the cells, tissue and the whole plant accumulated or stored as a result of chain of synthetic process of which raw material are basically provided by the photosynthesis. Thus the photosynthesis is the key point to make available the raw material for the growth.

Introduction

This paper is in continuation of the work on the effect of whey on the Hydrolytic Enzyme activity of some cereals and pulses seeds and their germination. Whey as waste material is considered as useless after removal of cheese from milk. Present work is aimed at exploring the use of the whey material.

Though there are a number of parameters to measure the growth of the plants, the rate of growth of the seedlings was expressed in terms of length of the root and shoot, area of the leaf and dry weight of the seedlings at fixed interval of period assuming that they are child plants and if they are kept healthy in childhood stage, they show better performance in later stage and yield considerable amount of fruit and seed. Chlorophyll and total sugar in the cotyledon leaf of seedlings was also determined.

The rate of growth of the seedling of crop plants undertaken, after the treatment of the whey to the seeds. Four parameters presently chosen would suffice the testimony that growth occurs more due to effect of the whey and least due to the untreated control.

Materials and Methods

Following procedure was adopted in the preparation of whey for the experimentation[1]:

One liter of Cow's milk was boiled after milking in stainless steel pot. It was mixed with 200 ml of whey taken from the confectioner and again boiled till curding.

It was cooled at room temperature nearly at 30°C and was filtered through three layers of thoroughly washed unused cheese cloth.

pH of the resulting whey was adjusted to 7 using 0.1 N NaOH solution by vigorous stirring.

Beakers containing seeds of paddy (*Oryza sativa* L), wheat (*Treiticum aestivum* L), green gram (*Vigna radiate* L), lentil (*Lens culinaris* Medic), Bengal gram (*Cicer arietinum* L) in whey were shaken time to time.

Distilled water was used for the control in place of whey.

The seeds treated as above were plated on sterilized moist blotter at the rate of 10 seeds per blotter and incubated at 30 ±1°C for four days.

Seeds were sown nearly 1.5 cm deep in the soil and 30 cm apart from the neighboring seeds. Light watering was maintained every alternate day.

Several parameters may be selected for measuring the growth of the seedlings. Amongst so many parameters, the length of the seedlings root, length of shoot, area of first leaf and dry weight of the seedlings were measured at an interval of 2 days after 7 days of germination.

Five seedlings from each plot was randomly taken out from the field with the help of weeding hook. Care was taken that no root would be damaged. After that seedlings were washed with running tap water taken in the big plastic tub. Special care was taken to avoid loss of rootlets and removal of soil particles adhering to them.

The length of the root and shoot was measured in cm of scale taking on flat sheet of paper. The area of leaf of seedling was measured by placing the leaf on the mm graph. In counting, the area less than half of 1 mm^2wasignored while more than half was counted as 1 mm^2. The total area was recorded in square mm or mm^2.

The rate of growth was observed by measuring the length on 7^{th}, 9^{th}, 11^{th}, 13^{th} and 15^{th} day of germination of seeds.

The seedlings after washing with water and soaking the adherent water with blotting sheets, were dried at 80°C in the incubator for 24 hrs and cooled over fused Calcium Chloride in sealed desiccators for next 48 hr, dry weight was taken on single pan balance.

Results and Discussion

The rate of increase in the root of seedlings of all the crop plants was faster due to treatment of the seeds with whey than the untreated control. Again on the 15^{th} day, the percent increase in the root length was considerably high, highest was in paddy and lowest in lentil (Table 1).

The rate of increase of the shoot of the seedling of crop plants was higher due to treatment of the seeds with whey than the control. Again on the 15^{th} day percent increase was considerably high, highest in mung and lowest in the wheat seedlings (Table 2).

The rate of increase in area of first leaf was higher due to treatment of seeds with whey than the untreated control. Again, the percent increase on the 15^{th} day was considerably high, highest in paddy and lowest in gram seedling (Table 3).

Table.1 Rate of growth of the root of Wheat, Paddy, Lentil, Gram and Mung seedlings after treatment of their seeds with whey (expressed as mean ± SE of length in cm)

Seeds	T/C	Day of observation					Increase (%) in growth of the roots on 15 day
		7th	9th	11th	13th	15th	
1	2	3	4	5	6	7	8
Wheat	T	2.18 ± 0.01	2.44 ± 0.01	2.70 ± 0.008	3.00 ± 1.09	3.35 ±0.02	39.00
	C	1.70 ± 0.02	1.91 ±0.01	2.03 ±0.01	2.21±0. 02	2.41±0. 02	
Paddy	T	2.23 ±0.01	2.53 ± 0.02	2.78 ±0.008	3.09 ± 1.09	3.47 ± 0.02	40.48
	C	1.74 ± 0.02	1.96 ± 0.01	2.09 ± 0.01	2.26 ± 0.02	2.47 ± 0.02	
Lentil	T	0.18 ± 0.01	0.26 ± 0.01	0.33 ± 0.01	0.40 ± 0.01	0.49 ± 0.01	28.94
	C	0.15 ± 0.01	0.21 ± 0.01	0.27 ± 0.01	0.33 ± 0.01	0.38 ± 0.01	
Gram	T	0.25 ± 0.02	0.35 ± 0.01	0.44 ± 0.01	0.53 ± 0.01	0.65 ± 0.01	20.00
	C	0.26 ± 0.01	0.28 ± 0.01	0.36 ± 0.01	0.43 ± 0.01	0.50 ± 0.01	
Mung	T	0.89 ± 0.01	1.24 ± 0.01	1.61 ± 0.01	1.94 ± 0.01	2.41 ± 0.01	31.69
	C	0.74 ± 0.01	1.04 ± 0.01	1.31 ± 0.01	1.61 ± 0.13	1.83 ± 0.01	

T: Treated C: Control

Table.2 Rate of growth of the shoot of Wheat, Paddy, Lentil, Gram and Mung seedlings after treatment of their seeds with whey (expressed as mean ± SE of length in cm)

Seeds	T/C	Day of observation					Increase (%) in growth of the shooton 15 day
		7th	9th	11th	13th	15th	
1	2	3	4	5	6	7	8
Wheat	T	2.17± 0.01	5.35± 0.01	10.83 ± 0.01	14.18± 0.01	20.50±0. 01	8.81
	C	1.68± 0.01	4.67±0. 01	10.08±0. 01	13.33±0. 01	18.84±0. 01	
Paddy	T	2.21±0. 01	5.47± 0.01	10.98±0. 01	14.29± 0.01	21.12±0. 03	9.54
	C	1.72± 0.01	4.73± 0.01	10.13± 0.01	13.69± 0.02	19.28± 0.01	
Lentil	T	0.37± 0.01	0.65± 0.01	0.93± 0.01	1.20± 0.01	1.50± 0.01	20.96
	C	0.31± 0.01	0.55± 0.01	0.73± 0.01	1.03± 0.01	1.24± 0.01	
Gram	T	0.50± 0.01	0.87± 0.01	1.23± 0.01	1.60± 0.01	2.01± 0.03	25.62
	C	0.40± 0.01	0.73 ± 0.01	1.04 ± 0.01	1.34 ± 0.01	1.60 ± 0.01	
Mung	T	1.93 ± 0.01	2.83 ± 0.01	4.11 ± 0.01	5.19 ± 0.01	6.44 ± 0.01	39.64
	C	1.21 ± 0.01	1.91 ± 0.01	2.93 ± 0.01	3.72 ± 0.02	4.61 ± 0.01	

T: Treated C: Control

Table.3 Rate of increase in the area of first leaf of Wheat, Paddy, Lentil, Gram and Mung seedlings after treatment of their seeds with whey (expressed as mean ± SE of area in mm^2)

Seeds	T/C	Day of observation					Increase (%) in leaf area growth on 15 day
		7th	9th	11th	13th	15th	
1	2	3	4	5	6	7	8
Wheat	T	570 ± 0.01	1272 ±0.01	1987 ± 0.01	2637 ± 0.01	3304 ±0.01	9.76
	C	944 ± 0.01	960 ±0.01	1277 ±0.01	2275 ±0.01	3010 ±0.01	
Paddy	T	598 ±0.01	1335 ± 0.01	2086 ±0.01	2769 ± 0.01	3469 ±0.03	10.09
	C	256 ± 0.01	1008 ± 0.01	1340 ±0.01	2389 ± 0.01	3151 ± 0.01	
Lentil	T	74 ± 0.01	156 ± 0.01	251 ± 0.01	348 ± 0.01	436 ± 0.01	7.92
	C	52 ± 0.01	137 ± 0.01	226 ± 0.01	316 ± 0.01	404 ± 0.01	
Gram	T	98± 0.01	208± 0.01	334± 0.01	464± 0.01	581± 0.01	8.39
	C	69± 0.01	182± 0.01	302± 0.01	421± 0.01	536± 0.01	
Mung	T	363± 0.01	778± 0.01	1253± 0.01	1753±0.01	2174± 0.01	8.48
	C	254± 0.01	683± 0.01	1130± 0.01	1573± 0.01	2004± 0.01	

T: Treated C: Control

Table.4 Rate of increase in dry weight of seedling of Wheat, Paddy, Lentil, Gram and Mung seedlings after treatment of their seeds with whey (expressed as mean ± SE of weight per seedling in mg)

Seeds	T/C	Day of observation					Increase (%) in dry weight on 15 day
		7th	9th	11th	13th	15th	
1	2	3	4	5	6	7	8
Wheat	T	36.5 ± 0.01	79.3 ± 0.01	130.3 ± 0.01	187.2 ± 0.01	357.8 ±0.01	21.34
	C	27.1 ± 0.01	67.1 ±0.01	113.6 ±0.01	127.4 ±0.01	294.2 ±0.01	
Paddy	T	37.2 ±0.01	84.1 ± 0.01	133.7 ±0.01	189.8 ± 0.01	366.4 ±0.01	24.02
	C	29.4 ± 0.01	69.4 ± 0.01	179.1 ± 0.01	129.2 ± 0.02	295.1 ± 0.01	
Lentil	T	3.0 ± 0.01	9.1 ± 0.01	14.8 ± 0.01	20.5 ± 0.01	26.5 ± 0.01	33.83
	C	2.1 ± 0.01	6.6 ± 0.01	10.6 ± 0.01	14.2 ± 0.01	19.8 ± 0.01	
Gram	T	4.1 ± 0.01	11.5 ± 0.01	19.8 ± 0.01	26.7 ± 0.01	35.1 ± 0.01	36.57
	C	2.8 ± 0.01	8.7 ± 0.01	14.1 ± 0.01	19.3 ± 0.01	25.7 ± 0.01	
Mung	T	15.4 ± 0.01	43.2 ± 0.01	73.6 ± 0.01	100.8 ± 0.01	131.5 ± 0.01	37.69
	C	10.8 ± 0.01	22.8 ± 0.01	53.1 ± 0.01	44.1 ± 0.01	95.5 ± 0.01	

T: Treated C: Control

The rate of increase in the dry weight of the seedling was faster due to the treatment of seeds with whey, than the control. Again, the percent increase on the 15th day, the increase in dry weight was considerably high, highest in mung and lowest in wheat (Table 4).

The rate of growth of the seedling of crop plants undertaken, after the treatment of the whey to the seeds undoubtedly was enhanced which is not only reflected in the elongation of the root and shoot and expansion of the leaf area but also the dry weight. The four parameters presently chosen would suffice the testimony that growth occurs and, too, more due to the effect of the whey and least due to the untreated control.

The growth involves initiation of the synthesis of proteins, DNA, RNA increase in the cytoplasmic content and a complicated metabolic reactions leading to the cell division and cell elongation. It is hoped that the content of the whey are capable of forging ahead the above metabolic reactions but it is a puzzle which of the step of reaction is being affected and by which compound. The ambiguity can be deciphered only after a thorough and meticulous investigation.

This is also evident that whey does not influence all aspect of the growth under reference of different plant. Such as maximum root and shoot elongation observed respectively in paddy, mung and dry weight of mung and leaf area in paddy. So the efficacy of the whey varies from species to species.

The hydrolysis of the stored food materials of the endosperm / cotyledons with gradual increase of the hydrolytic product there, and high amylotytic, starch phosphorylase and proteolytic enzymes and increase in the weight of different parts of the embryo (Damodran *et al.,* 1946; Ingle *et al.,* 1964; Palmiano and Juhiano, 1972; Matheson and Richardson, 1976; Helmer, 1985; Gifford *et al.,* 1986; Hodson *et al.,* 1987; Mayor and Polkokoff Mayber, 1989) of course not work out in this scheme, indicates the transfer of the soluble sugars and amino acids to the developing embryo which may be considered as parameter of growth of the seedling in inceptive stage.

The rate of growth of the shoot of cereal and pulses was of the same category as noted for the root of cereals under the influence of whey. The leaf expansion of paddy was found to be best. Similar was the fate of the mung. The increase in dry weight of the seedling of paddy was most benefitted by whey.

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