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IMPACT OF FOLIAR SPRAY OF GROWTH REGULATORS ON NUTRIENT DYNAMICS OF *TRIFOLIUM ALEXANDRINUM* L.

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Present paper reports the effect of foliar spray of different concentrations of growth regulating hormones (IAA, GA and 2,4-D) on nutrient dynamics (Nitrogen, Phosphorus and Potassium) of *Trifolium alexandrinum* L. The average percentage of Nitrogen, Phosphorus and Potassium in aboveground parts were observed in GA 50 ppm sprayed plots (3.8 ± 1.24, 0.48 ±0.18 and 0.81 ±0.18% respectively). The maximum uptake of nutrients in aboveground parts was found in GA 50 ppm sprayed plots (5590.65, 706.19 and 1191.69 gm-2 for Nitrogen, Phosphorus and potassium respectively). The maximum net loss of nutrients through litter and roots was observed in GA 25 ppm sprayed plots (491.54, 48.90 and 87.88 gm-2 for Nitrogen, Phosphorus and Potassium respectively). The cycling of Nitrogen, Phosphorus and Potassium were also analysed in the present study.

Key words : Foliar spray, growth substances, nutrient dynamics, *Trifolium alexandrinum.*

The bulk of dry matter is made up of organic compounds. The flow of nutrients and production of organic matter in an ecosystem are influenced by availability of nutrients and water (Chapman, 1976). The two sub-systems Viz. autotrophic level and soil serves as storage components in open reservior of atmosphere. From the autotrophic level, fluxes of nutrients keep on going to soil via formation of litter. The soil act as base of essential elements to the plants through roots in an ecosystem. The mobility of nutrients through plant-soil-atmosphere sub-systems constitute the nutrient cycling.

Plant absorb nutrients and transport them in to various parts for the production of organic compounds for their incorporation in their biomass (Kramer and Kozlowsky, 1960). In an ecosystem, the mineral capital is worked in a dynamic state to a series of inputs and outputs. Its input is regulated by storage and growth within the root system (Noggle and Fritz, 1976). The cycling of nutrients, the source of additional nutrients and the pathway by which they are lost, are of great importance in attempting to analyse and to understand the functional aspects of an ecosystem (Chapman, 1976).

The present investigation deals with the effect of IAA, GA and 2,4-D on standing state, uptake release and retention and cycling of Nitrogen, Phosphorus and Potassium in *T. alexandrinum* L., an important fodder crop.

MATERIALS AND METHODS

The study plots and treatments : The seeds of *T. alexandrinum* L. were obtained from G.B Pant University of Ag. and Tech., Pantnagar (U.P.).Complete random block design with seven plots with three replicate measuring 50 x 50 m size, were prepared. The water soaked seeds were sown in the flooded field on October, 30, 1989. Plots were irrigated after every 15 days in winter and after 7 days in summer. The spray treatments of IAA, GA and 2,4-D were given to the plots at vegetative (30 days), bud/flower initiation stage in control (120 days) and after the maximum dry matter obtained in control (180 days). Ordinary tap water was used in control plot for spray. The following concentrations of spray treatment was given in all the seven plots :

(i)	Plot I (T_1)	Control (Water spray)
(ii)	Plot II (T_2)	IAA 25 ppm
(iii)	Plot III (T_3)	IAA 50 ppm
(iv)	Plot IV (T_4)	GA 25 ppm
(v)	Plot V (T_5)	GA 50 ppm
(vi)	Plot VI (T_6)	2,4-D 25 ppm
(vii)	Plot VII (T_7)	2,4-D 50 ppm

Biomass sampling and nutrients estimation : Short term harvest method (Odum, 1960) was used to measure the biomass of the crop. Fifteen quadrats (25 x 25 cm) were laid randomly in each plot for the removal of aboveground standing crop. The aboveground parts were harvested with the help of sharp knife, 10 cm above the ground, leaving 10 cm stubble height. The

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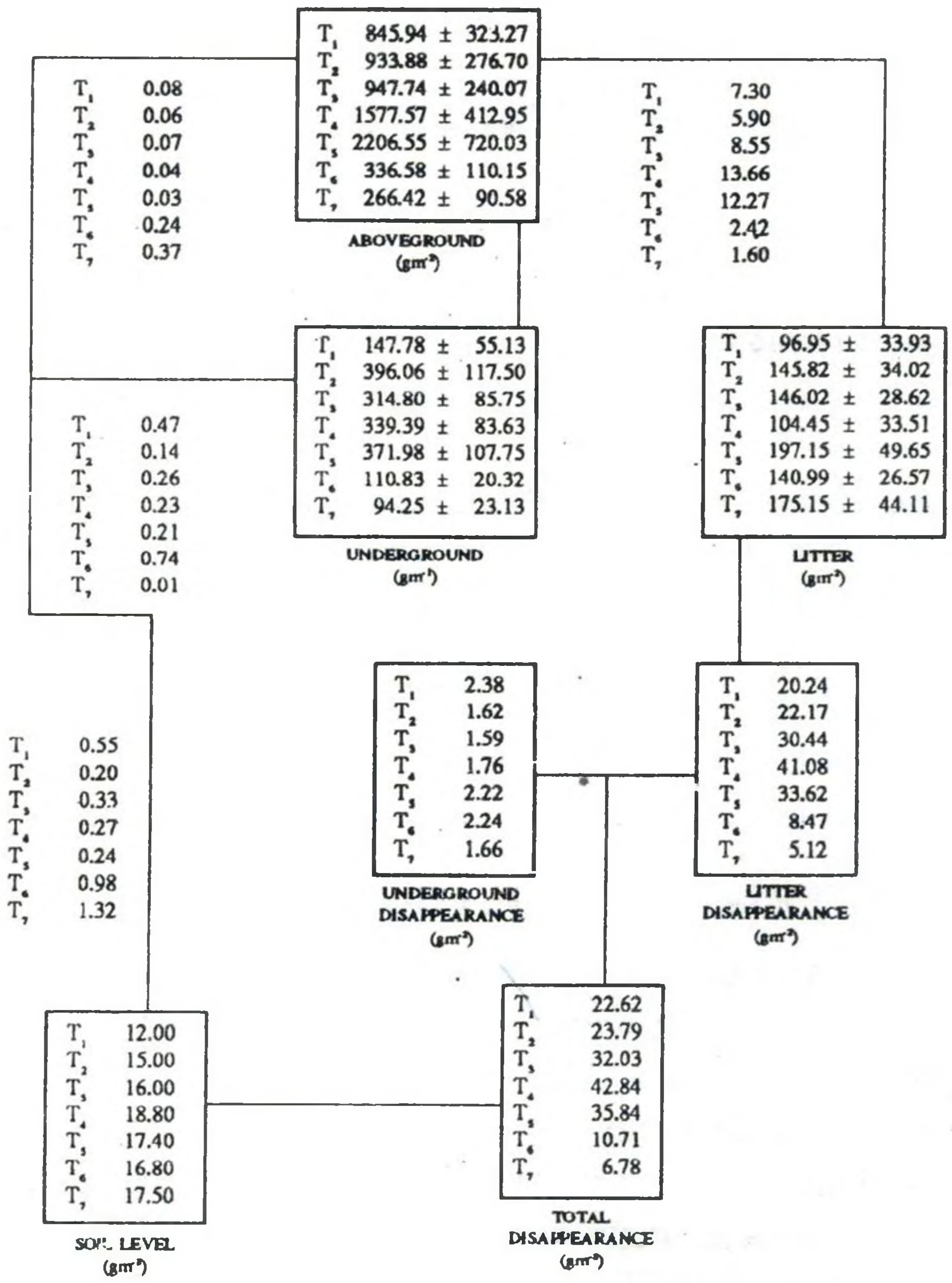

Figure 1. Nitrogen cycle in different compartments of clover grass vegetation as affected by the spray of different concentrations of GA, IAA and 2,4-D (After Billore and Mall, 1976 and Agrawal, 1988).

fallen dead material i.e. litter was collected separately after the area had been harvested for the aboveground vegetation.

For measuring the underground biomass, 15 monoliths of 25 x 25 x 30 cm size quardats were dug out on each sampling date from each plot. The monoliths were washed in running tap water using a mesh screen (pore size 500 nm). Loss of water soluble nutrients like Nitrogen and Potassium during washing the underground and litter material, was considered common to all sampling but could not be estimated through this investigation. The same area was never harvested again in the following months. The aboveground harvested material, gathered litter from each harvested plot and underground material were brought to the laboratory. All the above samples, thus obtained, were ovendried at 80°C for 24 hours.

Aliquots of the dried material collected on all occassions were mixed, ground and then passed through 200 mesh screen. Seperate samples were prepared for the above ground, litter and underground components.

Table 1: Average percent values of nutrients on dry weight basis (nitrogen, phosphorus and potassium) as affected by the spray of GA, IAA and 2,4-D in 25 and 50 ppm concentrations.

Treatment	Aboveground	Underground	Litter
	NITROGEN (%)		
T_1	2.8±1.07	2.6±0.97	2.2±0.77
T_2	2.7±0.80	3.00±0.89	2.4±0.56
T_3	2.8±0.71	2.9±0.79	2.5±0.49
T_4	3.4±0.89	2.8±0.69	2.4±0.77
T_5	3.8±1.24	2.9±0.84	2.7±0.68
T_6	2.2±0.72	2.4±0.44	2.6±0.49
T_7	2.0±0.68	2.2±0.54	2.7±0.68
	PHOSPHORUS (%)		
T_1	0.32±0.07	0.27±0.09	0.28±0.11
T_2	0.34±0.17	0.29±0.09	0.22±0.17
T_3	0.39±0.11	0.28±0.12	0.27±0.09
T_4	0.41±0.17	0.28±0.09	0.21±0.07
T_5	0.48±0.18	0.25±0.11	0.24±0.09
T_6	0.28±0.04	0.19±0.09	0.14±0.07
T_7	0.24±0.04	0.17±0.05	0.12±0.04
	POTASSIUM (%)		
T_1	0.56±0.11	0.44±0.08	0.27±0.07
T_2	0.61±0.17	0.60±0.19	0.31±0.11
T_3	0.67±0.22	0.52±0.11	0.33±0.17
T_4	0.77±0.19	0.50±0.17	0.44±0.18
T_5	0.81±0.18	0.44±0.08	0.47±0.12
T_6	0.46±0.19	0.37±0.09	0.24±0.09
T_7	0.49±0.22	0.39±0.11	0.21±0.05

Total nitrogen was determined by Kjeldahl method (Piper, 1944). For Phosphorus, wet digestion method was followed for digestion of the material and then by the calorimetric ammonium molybdate and stannus chloride solution method (Jakson, 1962). Potassium was estimated by flame photometer method (Peach and Tracey, 1956). Samples were analysed in triplicate and values were averaged to get average percent value of each nutrient.

RESULTS AND DISCUSSION

Standing crop of biomass (gm^{-2}): Variation in aboveground, underground and litter biomass was reported in the present study (Fig. 4) with maximum values in T_5 (580.67±65, 128.28±8 and 73.00±4 g^{-2} for aboveground, underground and litter parts respectively). However the minimum values were recorded in T_7 for aboveground 133.21±8 gm^{-2}) and underground parts (42.82± 5 gm^{-2}) and in T_1 for litter parts (44.07± 2gm^{-2}).

Chemical composition : Variation in mineral content was reported in aboveground, underground and litter compartments. Generally, the aboveground parts

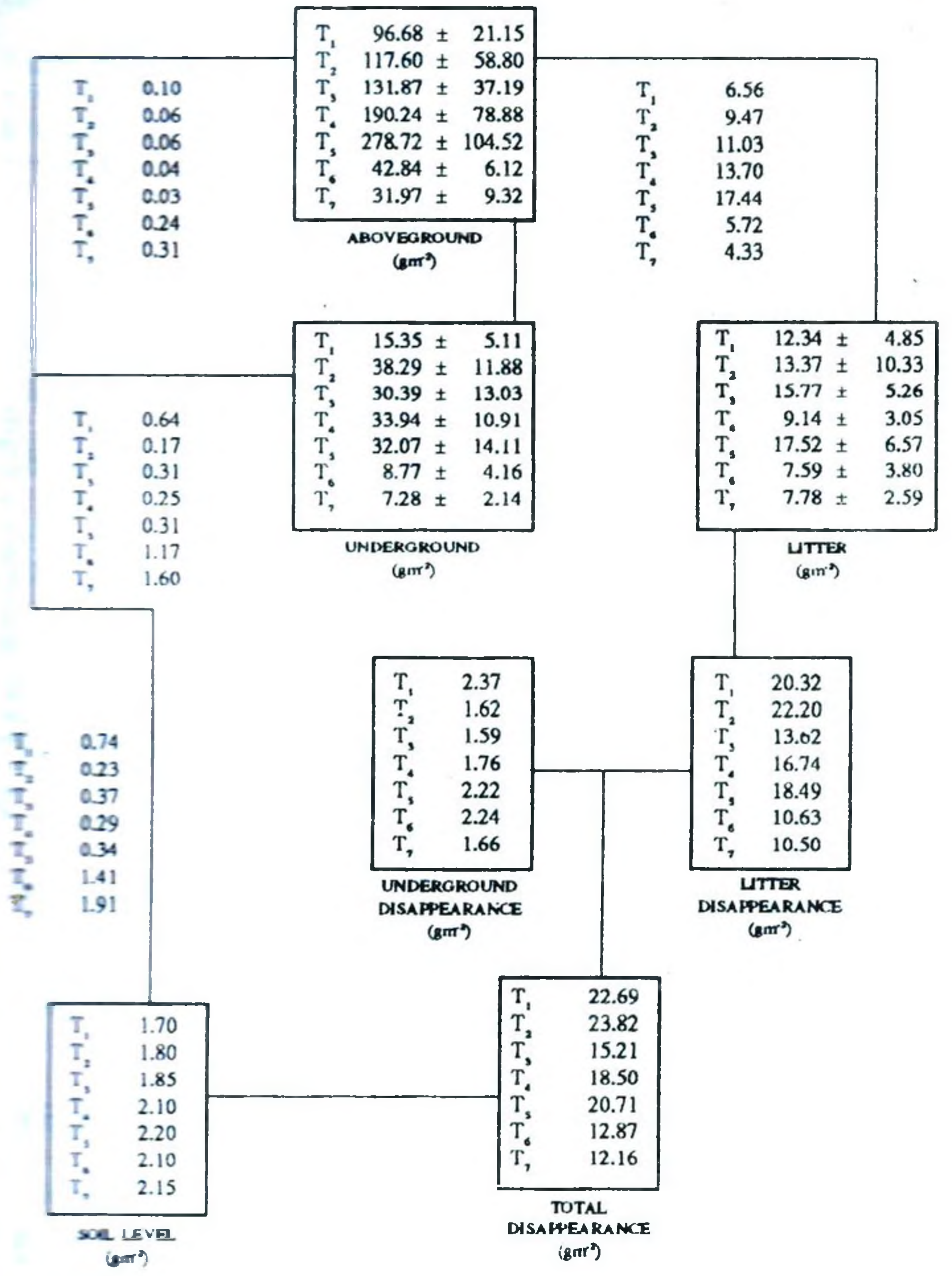

Figure 2. Phosphorus cycle in different compartments of clover grass vegetation as affected by the spray of different concentrations of GA, IAA and 2,4-D (After Billore and Mall, 1976 and Agrawal, 1988).

contained the highest amount of Nitrogen, Phosphorus and Potassium followed by underground parts and least in litter compartment. In treatments, the maximum amount of Nitrogen, Phosphorus and Potassium was found in T_5 plot in aboveground parts. In underground parts, maximum amount of nitrogen, Phosphorus and potassium was found in T_2 plot and in litter, the maximum percent value of nutrient was observed in T_5 plot (table 1). The relative proportion of the various elements differ considerably in different plant components.

Standing crop of Nitrogen. Phosphorus and Potassium (gm-2) : For the crop, the average standing state refers to the individual nutrient amounts in average (annual) biomass of the three components and are presented in table 2. The data reveal that maximum standing state of Nitrogen, Phosphorus and Potassium in aboveground and litter compartments was observed in T_5 plot. The maximum standing state of nutrients in underground parts was found in T_2 plot. On a comparision among the plant components, aboveground

Table 2. Standing crop of nitrogen, phosphorus and potassium (gm^{-2}) as affected by the spray of GA, IAA nd 2,4-D in 25 and 50 ppm concentrations.

Treatment	Aboveground	Underground	Litter
	STANDING CROP OF NITROGEN (gm^{-2})		
T_1	845.94±323.27	147±78±55.13	96.95±33.93
T_2	933.88±276.70	396.06±117.50	145.82±34.03
T_3	946.74±240.07	314.80±85.75	146.02±28.62
T_4	1577.57±412.95	339.39±83.63	104.45±33.51
T_5	2206.55±720.03	371.98±107.75	197.15±49.65
T_6	336.58±110.15	110.83±20.32	140.99±26.57
T_7	266.42±90.58	94.25±23.13	175.15±44.11
	STANDING CROP OF PHOSPHORUS (gm^{-2})		
T_1	96.68±21.15	15.35±5.11	12.34±4.85
T_2	117.60±58.80	38.29±11.88	13.37±10.33
T_3	131.87±37.19	30.39±13.03	15.77±5.26
T_4	190.24±78.88	33.94±10.91	9.14±3.05
T_5	278.72±104.52	32.07±14.11	17.52±6.57
T_6	42.84±6.12	8.77±4.16	7.59±3.80
T_7	31.97±9.32	7.28±2.14	7.78±2.59
	STANDING CROP OF POTASSIUM (gm^{-2})		
T_1	169.19±33.23	25.01±4.55	11.90±3.08
T_2	210.99±58.80	79.21±25.08	18.84±6.68
T_3	226.54±74.39	56.45±11.94	19.28±9.93
T_4	357.27±88.16	60.61±20.61	19.15±7.83
T_5	470.34±104.52	56.54±10.26	34.32±8.76
T_6	70.38±29.07	17.09±4.16	13.02±4.88
T_7	65.27±29.31	16.71±4.71	13.62±3.24

parts were found to contain the maximum and litter compartment, the minimum amount of Nitrogen, Phosphorus and Potassium (Table 2).

Nutrient budget : The compartment of the present cropland community were arranged in a block and arrow model (Billore and Mall, 1976) with each vegetational components considered as an independent cmpartment with an input and output (Fig. 1, 2 and 3). The values in rectangular boxes are the average standing states of the nutrients and were obtained by multiplying the average compartmental biomass with appropriate nutrient equivalents. These standing states are not as informative as the annual transfer rates (shown in figures by arrow between the compartments) since they are only approximation measure of the storage capacity of the compartments. The input and output of the three elements are those calculated from field data (Dhasmana and Agrawal, 1989). Net uptake is calculated from each nutrient equivalent community production (Table 3). The latter values were estimated by summing up the positive increments in the aboveground live and below ground biomass throughout the study period. Outputs of the net uptake of

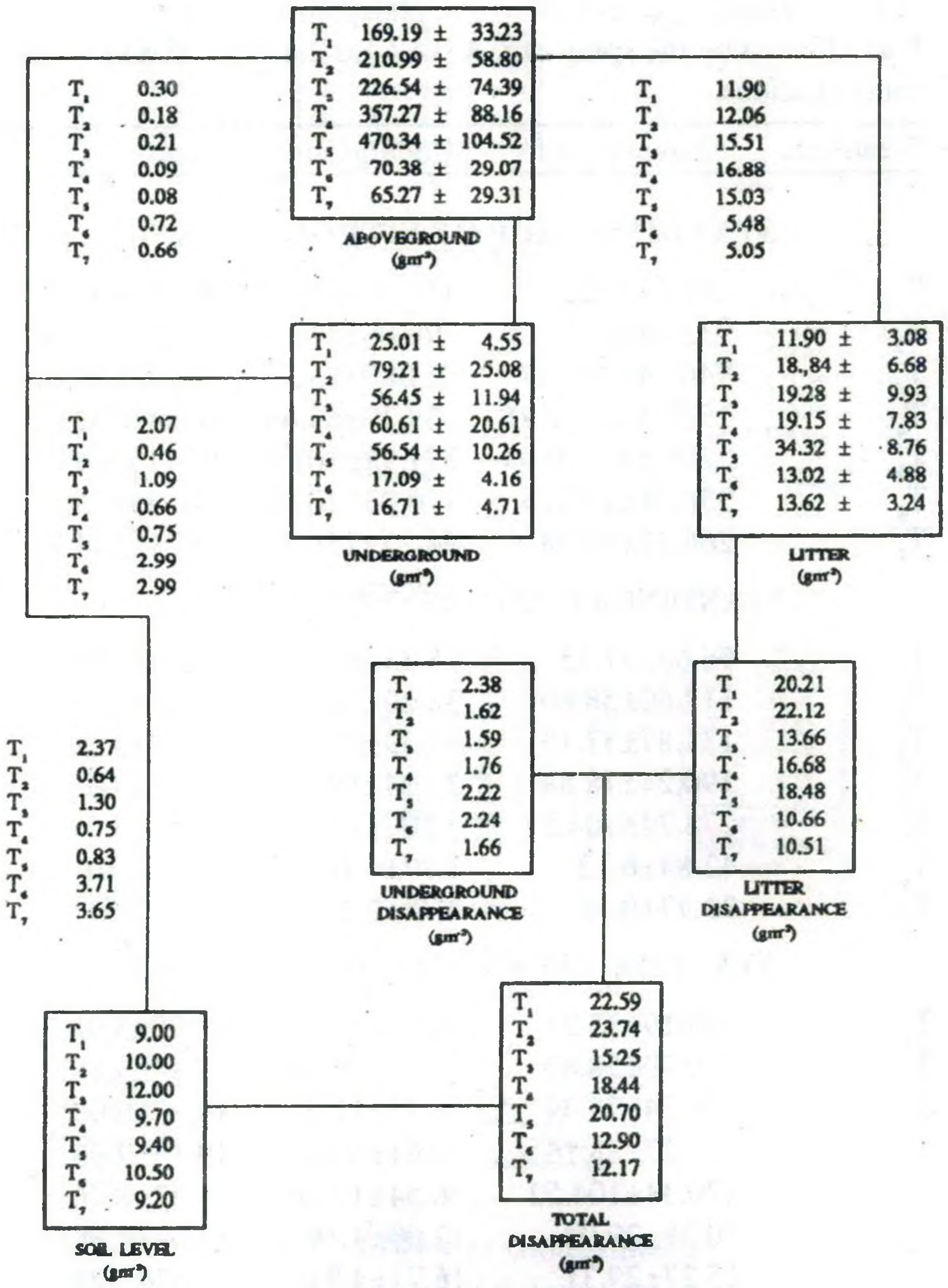

Figure 3. Potassium cycle in different compartments of clover grass vegetation as affected by the spray of different concentrations of GA, IAA and 2,4-D (After Billore and Mall, 1976 and Agrawal, 1988).

aboveground and litter and losses from litter and below ground biomass were calculated using the method of Sims and Singh (1971), Mall and Billore (1974) and Agrawal (1989).

Uptake, release and retention (gm^{-2}) : Table 3 presents the annual uptake, release and retention of Nitrogen, Phosphorus and Potassium. The difference between the uptake and release assumed to be the amount of nutrients retained by the plant components. The data suggest that on an annual basis, maximum uptake (5590.64, 706.19 and 1191.69 gm^{-2}), release (934.28, 81.77 and 151.93 gm^{-2}) and retention (4656.36, 624.42 and 1039.76 gm^{-2}) of Nitrogen Phosphorus and Potassium was found in T5 plot and minimum in T7 plot (uptake, 571.56; 68.59 and 140.03, release 22.39 and 42.74, retention 130.30 and 46.20 gm^{-2}) except release of Nitrogen (422.81) and retention of Potassium (94.37 gm^{-2}) in T6 plot.

It was observed in the present investigation that T_4, T_5 and T_2, T_3 increased the nutrient concentration in all

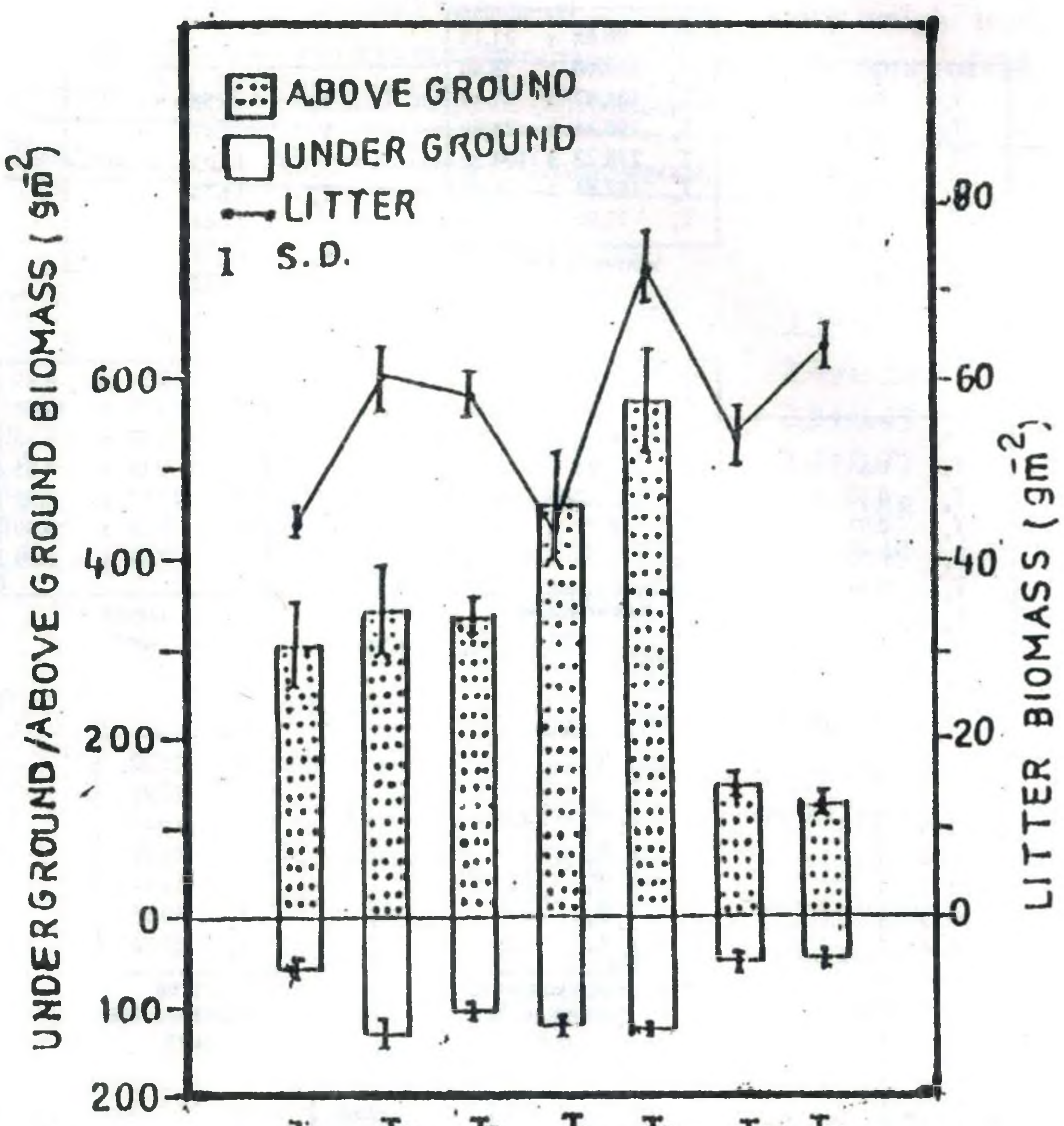

Fig. 4 Biomass (gm^{-2}) aboveground, underground and litter on dry weight basis under different treatments

the components from control but 2,4-D in 25 and 50 ppm concentrations decrease it considerably. the above findings are supported by the work of Kumar (1982) on *Arachis hypogea* and Dhasmana (1985) on *Medicago sativa*.

These three elements are highest in living tissue (aboveground and underground) and they decrease as the plant material degenerates to the litter stage. This decline may be due to weathering or to leaching by rains or by translocation away from the dying tissue. The amount of Nitrogen stored in live parts of the plant was higher than for Phosphorus and Potassium (Table 2). These differences may be attributed to their availability in the system (Agrawal, 1988).

It can be concluded from this study that on the spray of GA 50 ppm yields maximum harvestable nutrients in clover grass and the same may be recommended for the improvement of the nutrient status of the fodder crop.

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Table 3. Total uptake and losses of various nutrients as affected by GA, IAA and 2,4-D in 25 & 50 ppm

Components		T_1	T_2	T_3	T_4	T_5	T_6	T_7
				NITROGEN				
Soil level (gm^{-2})		12.00	15.00	16.00	18.80	17.40	16.80	17.50
Net uptake (g/m^2)	aboveground	1514.88	2421.39	2362.53	4599.93	5590.64	692.71	571.56
	underground	256.36	1081.20	616.40	828.10	827.68	227.66	173.67
	litter	207.48	351.12	276.20	336.70	455.49	286.39	356.67
Net loss (g/m^2) from	litter	10.25	15.84	20.25	20.16	24.62	26.88	33.91
	underground	107.90	669.39	387.25	471.38	373.26	101.44	104.72
Total net losses (g/m^2)		118.15	685.23	407.50	491.54	397.88	128.32	138.63
				PHOSPHORUS				
Soil level (g/m^2)		1.70	1.80	1.85	2.10	2.20	2.10	2.15
Net uptake (g/m^2)	in aboveground	173.13	304.92	329.07	554.70	706.19	88.16	68.59
	underground	26.62	104.52	59.51	82.81	71.35	18.02	13.42
	litter	26.41	32.19	29.83	29.46	40.49	15.42	15.85
Net loss from (g/m^2)	litter	1.30	1.45	2.19	1.76	2.19	1.45	1.51
	underground	11.21	64.71	37.39	47.14	32.17	8.03	8.09
Total net losses (g/m^2)		12.51	66.16	39.58	48.90	34.36	9.48	9.60
				POTASSIUM				
Soil level (g/m^2)		9.00	10.00	12.00	9.74	9.40	10.50	9.20
Net uptake (g/m^2)	in aboveground	302.98	547.05	565.32	1041.75	1191.69	144.84	140.03
	underground	43.38	216.24	110.53	147.88	125.58	35.10	30.79
	litter	25.46	45.35	36.46	61.73	79.29	26.44	27.74
Net loss ((g/m^2)	from litter	1.26	2.05	2.67	3.70	4.29	2.48	2.64
	underground	18.26	133.88	69.43	84.18	56.64	15.64	18.56
Total net losses (g/m^2)		19.52	71.48	72.10	87.88	60.93	18.12	21.20

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